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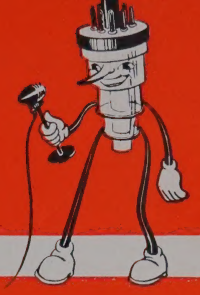


JANUARY—FEBRUARY, 1951

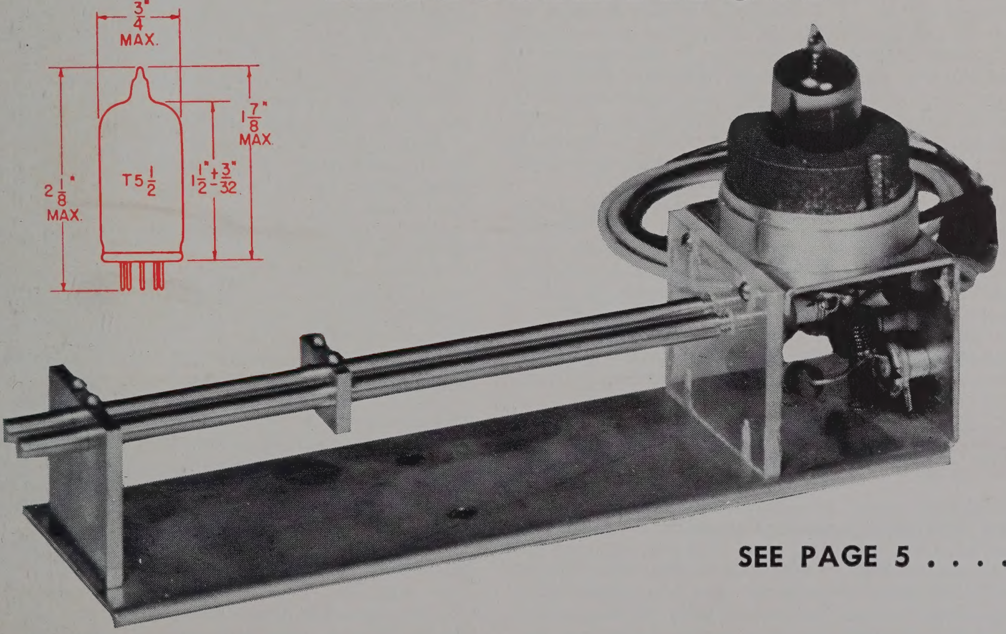
VOL. 6—NO. 1

ELECTROPHONE

An Inexpensive Condenser Microphone for the Home Experimenter

. . . . ARTICLE ON ELECTROPHONE STARTS ON PAGE 2

Announcing the New UHF Miniature MAGNETRON



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ELECTROPHONE

Many items around almost any ham shack are home-made. Some amateurs make their own transmitters, some their own receivers, but very few amateurs have ever made their own microphone. This has been due primarily to the fact that it is difficult and expensive to make a microphone of good quality. The microphone about to be described is the exception to the rule, as it is easy to make and is a good quality microphone.

The Electrophone is a condenser microphone of novel construction which requires no external source of polarizing voltage. Very few parts are required to make the Electrophone, and almost any amateur can put one together in an evening. The output is higher than can be obtained from a regular condenser microphone, and if the Electrophone is carefully made, the output will almost be equal to that from a crystal microphone.

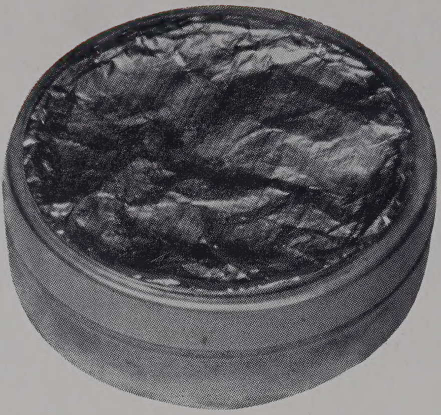

Fig. 1. View of Electrophone showing aluminum foil diaphragm

CONDENSER MICROPHONES

The regular type of condenser microphone consists of a small capacitance which may be varied by the pressure of sound waves impinging on one of the condenser plates. If a source of direct current is placed in series with this condenser the current will vary as the capacitance changes. If this current is passed through a relatively high resistance a varying voltage drop will exist across this resistance. The variation in voltage drop will take place at an audio rate, and if the high resistance is placed in the grid circuit of a tube amplifier, the audio frequency voltage may be amplified in a normal manner.

The fixed voltage source which provides the direct current is called a polarizing voltage. This voltage serves, in a condenser microphone, in the same way as the voltage in a carbon microphone, although the action of the two types of microphones is quite different.

No external polarizing voltage is necessary with the Electrophone, because it supplies its own internal source of voltage. This voltage is supplied with an electret.

ELECTROPHONE ELECTRET

An electret may be compared to a permanent magnet. That is, a permanent magnet is a continuous source of electromagnetic lines of force, whereas an electret is a continuous source of electrostatic lines of force. It is usually made in the form of a disk of insulating material which has permanently residing on its two flat surfaces electrical charges equal but opposite in sign.

Fig. 2 shows the manner in which the electret, having a positive charge on its upper surface and a negative charge on the lower, induces charges on the two plates forming the condenser microphone. The electric lines of force may be thought to travel from one electric pole to the other just as we have been accustomed to thinking of the magnetic lines of force in a permanent magnet with a north and a south pole.

Electrets themselves are not new, nor are condenser microphones employing electrets new, that is, it has always been theoretically possible to make a microphone in this manner. The Electrophone is a practical example of this sort of thing. The word electret was coined by Oliver Heaviside in the latter part of the nineteenth century to denote a permanently charged material, but the first electret was not made until 1925.

MAKING THE ELECTRET

The electret is the heart of the Electrophone, and should be made as carefully as possible. The general procedure is to take a piece of suitable insulating material and apply heat to it while a d-c voltage is applied across the two faces. Both the heat and the voltage necessary are critical, although not sufficiently critical to cause the constructor any trouble.

It is absolutely necessary to use the proper insulating material in preparing the electret. Those materials recommended are Lucite, Plexiglas or Kel-F. One material which will not work is polystyrene. If you are in doubt as to whether the material you have is polystyrene, Plexiglas or Lucite, a simple flame test may be made. Polystyrene burns with a smoky flame, while Lucite and Plexiglas burn with a clear blue flame.

Once you have the proper material, select a piece about one-sixteenth inch thick and cut it in the shape of a circle. The exact diameter of the circle will depend upon the microphone case you use. These details will be discussed later. Next, procure a heavy pan or thick piece of metal (see Fig. 3). The purpose of the large mass of metal is to maintain as uniform a temperature as possible on the electret.

The next item necessary is a power supply which will give a voltage of anything from 1000 volts up to approximately 10,000 volts. The higher the voltage that is used, the better a microphone you will have, from the standpoint of sensitivity. Ideally, use as high a voltage as possible without causing arc-over between the two polarizing voltage electrodes.

A satisfactory microphone may be made with 1000 volts, but for best results use at least 2500 or 3000 volts, and if you want to do a superior job, use 10,000 volts. The job of providing a power supply is not as difficult as it may sound, because only a few *microamperes* of current are required.

In case you haven't already guessed it, the best place to obtain a high voltage which is capable of only a small amount of current is a television receiver.

An r-f power supply of this type is ideally suited, not only because the voltage runs quite high, but also because there is much less danger involved in using such a power supply. However, regardless of the type of voltage supply used, remember that high voltages are dangerous and extreme caution must be exercised so as to avoid contact with the high voltage.

If you are unable to obtain a high voltage supply, one may be put together for the purpose. Fig. 5 shows a suggested circuit for a high-voltage power supply.

Once everything is ready, we may proceed to make the electret. Place the large pan or piece of metal on a source of heat. A burner in a gas or electric stove is quite suitable. Arrange the insulating material on top of the pan as shown in Fig. 3. Procure a top electrode (you may use the top of the microphone case as explained later) and place it on top of the insulating material, making sure that it is centered so as to prevent arc-over.

Next, connect the negative voltage supply to the bottom electrode, and also to the stove, then connect the positive lead from the power supply to the top electrode. Now, leaving the voltage supply turned off, turn on the heat and bring the insulating material up to temperature. Plexiglas and Lucite should be brought to a temperature of 140 degrees Centigrade (285 degrees Fahrenheit) and Kel-F should be heated to 205 degrees Centigrade (400 degrees Fahrenheit).

These temperatures are not too critical and one may use the softening point of the plastic as a convenient guide instead of using a thermometer. Each of the temperatures listed is the point at which the insulating material begins to soften. If desired, a small piece of the material may be placed in the pan and used as a test piece. Examine it with a fork periodically and when it becomes soft the larger piece will be at about the proper temperature.

At the moment when the plastic has reached the proper temperature, turn on the high voltage supply and leave it on for two hours. During this two-hour period the temperature of the plastic should be maintained at the temperatures previously mentioned. In general the heat will have to be turned down a bit in order that the temperature is not increased. Keeping an even temperature is not difficult if a large body of metal is used as indicated. After two hours, turn off the heat, but keep the high-voltage supply on. When the insulating material has cooled down to room temperature, disconnect the high voltage.

If you wish to check the actual temperature of the electret to ascertain if it is cool, remember to turn off the high voltage. Also, do not touch the face of the electret, either at this time or at any later time, as continuous handling of the electret will eventually ruin it. When you have finished with the electret, wrap it in metal foil until you are ready to mount it in the Electrophone. Any spare electrets you may have made should also be stored in this manner.

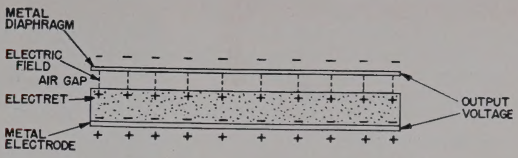

Fig. 2. Cross section of Electrophone

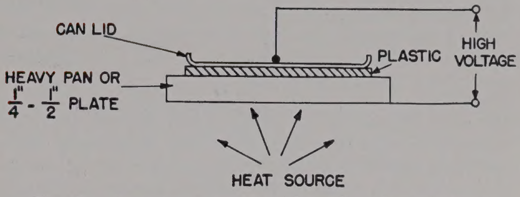

Fig. 3. Arrangement for charging the electret

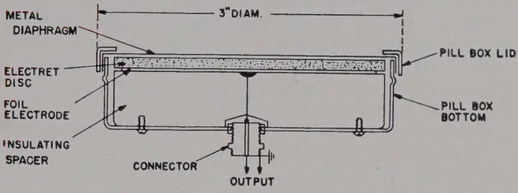

Fig. 4. Cross section of Electrophone showing constructional details

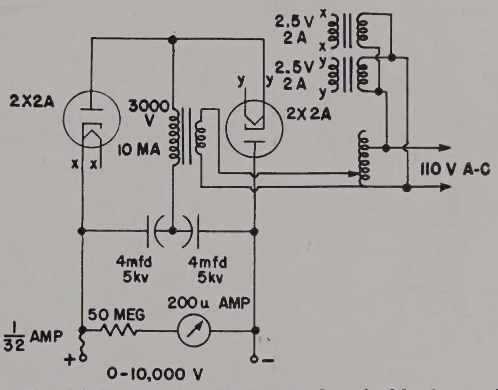

Fig. 5. High voltage power supply suitable for making electret

COMPLETING THE MICROPHONE

Amateurs with machine shop facilities will no doubt be able to make a very fancy housing for the microphone, but metal pill boxes or salve cans, three inches in diameter and one inch thick are available at most drug stores or drug supply houses, and these make an ideal case for the Electrophone. The photographs show quite clearly how these salve cans are employed. The top of the salve can can be used as the top electrode when making the electret, as it has a rounded and curved-up edge which helps prevent voltage flashover.

After the can top has been used in this manner, the center of it may be cut out as shown in Fig. 1. The hole should have a diameter of approximately 2¾ inches. A standard meter punch may be used, or the area may be chiseled out neatly.

The next step is to provide the main body of the salve can with a connector of some sort. The type shown in Fig. 6 is a standard microphone connector of the sort that you might normally put on the chassis of your speech amplifier. Mount this connector in any convenient manner.

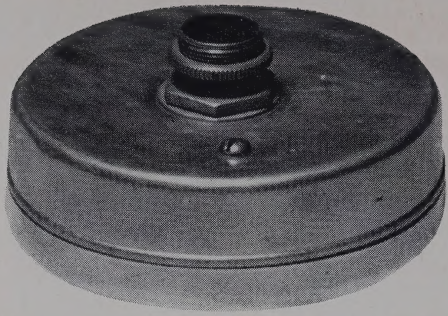
Fig. 6. Rear view of Electrophone showing microphone connector

Referring to the cross-section view of the Electrophone, Fig. 4, you will note that an insulating spacer is required. This can be almost any substance, although the regular plastics will probably work the best. Its diameter should be such as to clear the inside of the can (in our case 2⅞ inches) and its thickness should be adjusted to locate the outer surface of the electret just flush with the edge of the can, as shown in the sketch. Two holes may be drilled and tapped in the bottom of the insulating material to hold it to the bottom of the can.

A clearance hole for the output connector must be placed in this plastic, and also a hole must be drilled through the piece, in the center, in order to make contact with the foil on the bottom of the electret. To mount the insulating spacer, first solder a piece of bare wire to the output connector, then slip the insulating spacer into the can while feeding the wire through the center hole in the spacer. Next, fasten the spacer down with the machine screws and cut off the wire that protrudes above the spacer.

With a hot soldering iron a little depression about ¼ inch in diameter is melted out around the wire and a ball of solder formed in this depression. The solder should protrude slightly above the surface of the spacer so that it may serve as a blunt contact point.

It is now time to take the electret out of its protective foil wrapping and mount it in the can. Before this is done, however, you must prepare a piece of metal foil—preferably aluminum foil of the sort that is sold in grocery stores—to use as the back electrode on the electret. Cut a circle of foil with a diameter one-fourth inch less than that of the electret. Place this piece of foil on one side of the electret, and press it firmly in place. Make sure that you get it in the right position to start with, as you will not be able to slide the foil once it touches the surface of the electret. A suggested way to do this is to place the electret face down on a large piece of foil, then carefully place one edge of the circular piece about one-eighth of an inch from the side of the top face of the electret, and slowly lower the piece of foil, keeping hold of it until you are sure that it is centered. Once it is on, carefully, but firmly, press the foil against the electret.

Finally, cut a larger piece of foil to use as a diaphragm, and place it over the top of the can (before the electret is put in) and fold it around the sides, trimming the edges to make a neat job. Now, remove the large piece of foil, place the electret in position, place the large piece of foil over the electret, and put the top of the can in place. The microphone should now look as shown in Fig. 1.

Ideally the top piece of foil should remain suspended above the surface of the electret with as close spacing as possible, but in the practical sense it does not matter if the foil touches the electret in a few spots. However, do not press the outer foil against the surface of the electret, as the more contact area that exists, the less output you will get from the microphone.

Many modifications of this construction will undoubtedly suggest themselves to the experimenter. The important thing to remember is that dimensions are not critical and an experimenter need not be hesitant to construct a working microphone of this type.

PERFORMANCE

Several Electrophones have been in use at W2UKL for over a year and no decrease in the output voltage of 0.02 to 0.03 volts has been observed. Some experimenters have observed electrets for twelve years without noticing any substantial decrease in charge. No attempt was made to protect them from humidity other than keeping them in their mounting cans.

No feedback troubles have been experienced and the Electrophone was merely plugged in to an existing crystal microphone input jack on the speech amplifier. The quality is good and on-the-air tests showed the Electrophone to compare favorably with a crystal microphone.

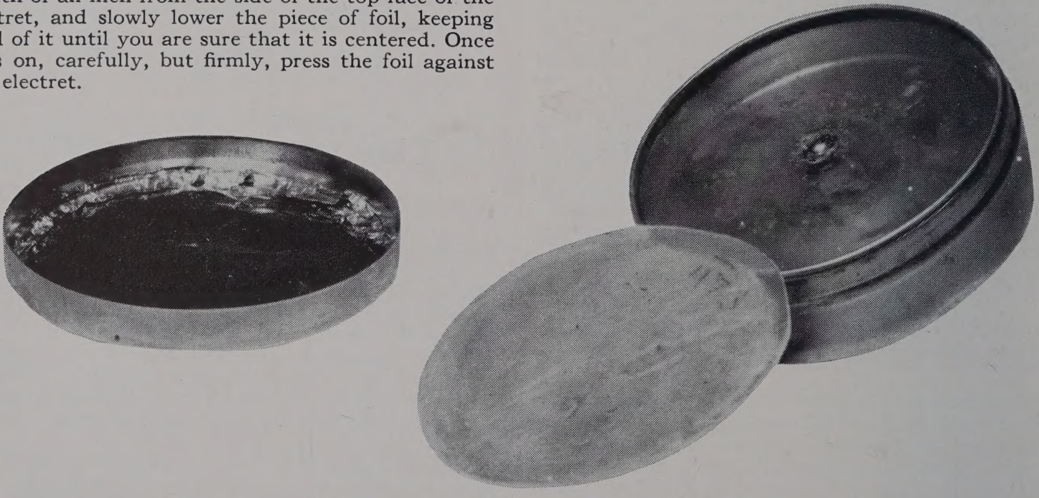
Fig. 7. Disassembled view of Electrophone

The New UHF Miniature Magnetron

The new miniature magnetron tube recently announced by the General Electric Tube Divisions will undoubtedly find itself in many ham shacks in the near future. This tube is capable of operating continuously from 30 to 900 megacycles at a quarter-watt output.

Although designed primarily for television receivers operating in the proposed ultra-high-frequency television band, the Z-2061 will find wide use wherever a low power oscillator at these frequencies is required. The price of the Z-2061 will be comparable with other television receiver tube prices, which means that the amateur finally will be able to procure a low cost tube for operation on the ultra-highs.

Up to this time, magnetrons have been used to generate the high power required for radar equipment and counter-radar equipment used extensively during World War II. During this time the magnetron was not generally thought of as a practical device for TV home receivers, but through the combined efforts of the G.E. Laboratories and the Tube Divisions, the magnetron principal has now been successfully applied to make it a useful tube for the proposed UHF television band.

Generally speaking, a magnetron is a diode which, when operated in a magnetic field, can be made to generate radio frequency oscillations. In the case of the Z-2061, the magnetic field is supplied by a doughnut-shaped magnet, which fits over the tube. The magnetic field strength required is approximately 600 gausses. When the tube circuit is initially adjusted, it is necessary to rotate the magnet until the magnetic poles are in the proper position for operation.

A typical test oscillator for the miniature magnetron is pictured in Figs. 8 and 9. This oscillator in appearance is not unlike others with which the amateur is familiar. The circuit of the test oscillator is given in Fig. 10. It is not particularly intended to be duplicated by amateurs or experimenters but it does indicate how simple a circuit may be used.

Tuning, in the test oscillator pictured, is accomplished by changing the position of the shorting bar on the two anode lines. The oscillator pictured may be tuned over the range from 300 to 900 megacycles. Output may be obtained by coupling to the anode lines in a manner similar to the method used with other parallel line oscillators.

Internally, the Z-2061 consists of eight vanes arranged in a circle around the cathode. Alternate vanes are connected together, so that each anode consists of four vanes. The entire tube is therefore seen to consist of 8 vanes, a cathode and a filament. Dimensions internally are large enough so that no critical spacing is involved.

Tests indicate that the tube has good frequency stability, both for voltage changes and magnetic field variations. Further, the hum and noise level is down more than 60 db below carrier level.

An early issue of the *Ham News* will give constructional data on equipment designed for amateur services and employing the Z-2061.

—*Lighthouse Larry*

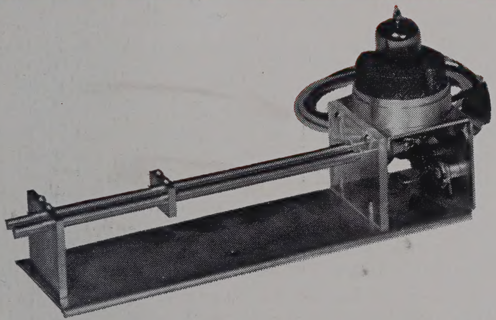

Fig. 8. Experimental test arrangement for Z-2061 magnetron

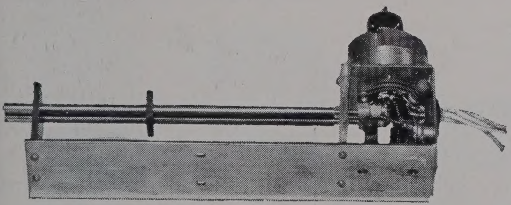

Fig. 9. Underside view of Z-2061 test setup

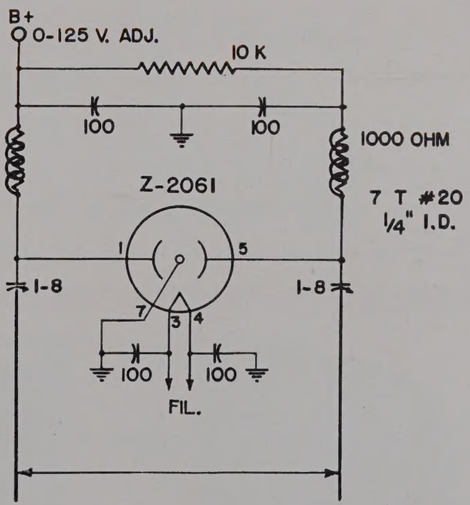

Fig. 10. Circuit diagram of Z-2061 test set

Technical TIDBITS

USING RESISTORS AS R-F LOADS

The practice of testing an amateur transmitter while it is coupled to an antenna is quite common, despite the fact that the F.C.C. frowns on such doings. While testing an antenna system, of course, it is necessary to be on the air, but for most transmitter tests a dummy load is desirable. Use of a dummy antenna not only obviates unnecessary QRM but, if a known dummy load is employed, quantitative measurements of actual power output can be obtained.

The purpose of this article is to explain how to procure a good dummy load, and how to use it.

TYPES OF DUMMY LOADS

Anything which will absorb power and not act as an efficient r-f radiator may serve as a dummy load. As we know, an electric light bulb can be used. As a matter of fact, it is possible to use a tub of salty water as a dummy load. In actual practice most amateurs use either a light bulb or non-inductive resistors.

Electric light bulbs have one big disadvantage, and that is, their resistance varies with the amount of current passing through them. If the resistance of a dummy load is not known accurately, then it is impossible to make any accurate output measurements. However, in the case of the light bulb, most amateurs judge output by the amount of brilliance in the lamp. Unfortunately this can be most misleading, because a large change in the amount of power dissipated may be indicated by an imperceptible change in brilliance.

Non-inductive resistors are perhaps the logical choice for use as dummy loads, if only because they have fewer disadvantages than other types of loads. The cost of these units is surprisingly low, and properly handled, they will be a permanent investment. For this reason all further discussion will be restricted to the use of resistors as dummy loads.

RESISTORS IN GENERAL

Many different types of resistors are currently manufactured, but those in widespread use fall into two general categories: the composition type and the wire-wound type. Composition resistors are seldom used for dissipation of more than 2 watts, although they are available in 5 watt sizes. Wire-wound resistors are available with dissipation ratings up to 200 watts.

Composition types of ¼, ½, 1 and 2 watt ratings are made in resistance values from 10 ohms to 20 megohms. For lower resistance values, these same wattage ratings can be obtained in wire-wound units only. For example, one manufacturer makes ½ watt wire-wound units in the resistance range from 0.47 ohms to 820 ohms.

Wire-wound units can be obtained in resistance ranges from a few tenths of an ohm up to 250,000 ohms, but not all wattage ratings and styles are available over this complete resistance range.

All resistors will not serve as usable dummy loads. Those which are usable are the composition type and the non-inductive wire-wound type. The criteria here is lack of inductance.

A wire-wound *inductive* resistor will not serve as a dummy load at radio frequencies because its relatively high inductance will not permit a current flow unless a tremendous voltage is available.

For example, assume that a regular inductive resistor has an inductance of 100 millihenrys, and a resistance of 100 ohms. An inductance of 100 millihenrys at 14 megacycles is an inductive reactance of 9,000,000 ohms! One ampere of current, representing a real power of 100 watts into this resistor, would require that 9,000,000 volts be applied to the resistor. This example assumes that the inductive resistor had zero capacitive reactance, which is not possible, but the example does serve to illustrate why it is difficult to get power into an inductive resistor at these frequencies—unless a difficult tuning job is attempted.

COMPOSITION RESISTORS

A simple equivalent circuit of a composition resistor is shown in Fig. 12-A, where R is the d-c resistance and C the total capacitance across the resistor. The equivalent circuit will not hold strictly true for all frequencies but it suffices for most generalizations.

At frequencies up to approximately 100 megacycles the inductance may be neglected (except for very low values of resistance). The total capacitance is also low, being less than one mmf (when considering composition resistors in the resistance range below 1000 ohms). The effective capacitive reactance is high enough that it presents no problem.

In other words, composition resistors are good for use at radio frequencies. They will act as though they are a pure resistance—within limits. The main disadvantage of these units is that they are available only in low-wattage styles. This need not be too serious a drawback, as will be explained later.

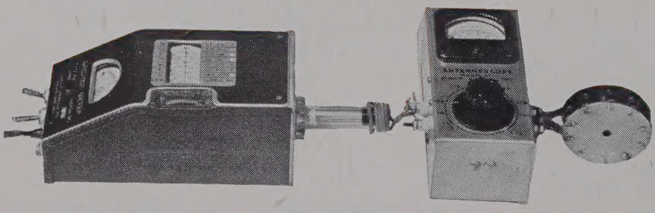

Fig. 11. Arrangement used for testing resistors

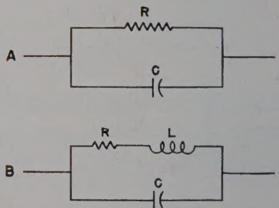

Fig. 12. Equivalent circuits

WIRE-WOUND RESISTORS

Fig. 12B shows the simple equivalent circuit of a wire-wound resistor. This will hold true in a general way for both inductive and non-inductive units, where R is the d-c resistance, C the total capacitance, and L the total inductance. In the case of non-inductive units, L is the residual inductance. However, because of such factors as skin effect and dielectric loss there will be some limiting frequency where this circuit is no longer valid.

As frequency is increased the inductive reactance increases proportionately and the capacitive reactance decreases proportionately. Both of these effects are undesirable. Regular wire-wound resistors cease to be resistors in the true sense of the word at frequencies slightly above the *audio* range.

For radio-frequency uses it is necessary to go to the so-called non-inductive resistors. These are manufactured in such a way that the inductance is kept at a minimum. One popular scheme is the Ayrton-Perry winding in which two layers of wire are wound in opposite directions. As an example of what may be accomplished, one manufacturer states the inductance of a wire-wound unit at 66 microhenrys and the inductance of an identical value non-inductive unit at 0.6 microhenrys.

Generally speaking, non-inductive wire-wound resistors are not as good for use at radio frequencies as composition resistors, but the wire-wound units are capable of dissipating a great deal more power, and by the proper choice of unit satisfactory operation may be obtained.

POWER CONSIDERATIONS

Before discussing which resistor to use where, it might be well to consider power ratings. If you have a kilowatt transmitter, with an output of 750 watts, it might seem necessary to have a dummy load capable of dissipating this amount of power. However, this is not true, because it is possible to use resistors (both the composition type and wire-wound type) at several times their rating.

Tests have been made to determine the amount of overload which may be placed on resistors, and the following conclusions may be drawn. A resistor, or resistors of the composition or wire-wound type, may be used at 300% overload if the overload is applied for not longer than one minute, and if a fifteen minute cooling-off period is allowed between successive on periods.

Inasmuch as most tests can be conducted in a sixty-second on period, there is no need to use resistors which are capable of dissipating the full amount of power. As a matter of fact, if it is desirable to use resistors for long test periods, it may be necessary to have a safety factor involved unless adequate ventilation is provided for the resistors. That is, for long test periods, you should use resistors capable of dissipating twice the power you apply to them.

CHOOSING A RESISTOR

Now that we have a general idea of the power rating we may need, let's see what resistors we can use for various power levels.

For measurement or antenna matching work, where you usually use your VFO or a grid-dip meter for a power source, half-watt composition resistors are adequate, power-wise. For impedance values of 50, 75 or 100 ohms, single unit ½ watt resistors are good up through 150 megacycles. For 300 ohm work, a single 300 ohm resistor is not satisfactory, as the effective capacitive reactance starts to show up at 100 megacycles. However, two 150 ohm ½ watt resistors in series are satisfactory up to 150 megacycles.

No tests were made on resistors of more than 300 ohms resistance, but it is obvious that the capacitive reactance will be a factor to be considered, so that higher and higher values of resistance will be "pure resistance" only for lower and lower frequencies.

Dummy loads capable of handling sixty watts (the output of a 100 watt input transmitter) can be made by employing 2 watt composition resistors. Ten 2 watt resistors will dissipate twenty watts, which, with our factor of three employed, allow their use as 60 watt loads. Obviously, these resistors can be placed either in series or in parallel, but tests indicate that it is desirable to make these loads as follows.

For a 50 ohm load use ten 500 ohm resistors in parallel. For a 75 ohm load, use ten 750 ohm resistors in parallel. For a 300 ohm load, use ten 30 ohm resistors in series. All of these combinations give good results as dummy loads up to 150 megacycles.

The proper way to parallel resistors is indicated in Fig. 13. Make two circular disks of copper or brass, and drill ten holes, equally spaced, around the edge of each disk. Mount the resistors between the disks and solder each lead to the disk. If desired, a coaxial fitting may be mounted, as shown, or broad straps may be soldered to the two disks.

If you use a 300 ohm load, the resistors should be in series. The best way to do this is to make two sets of

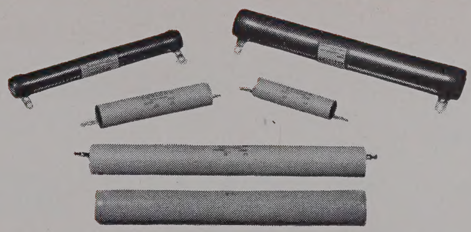

Fig. 14. Examples of high-power resistors

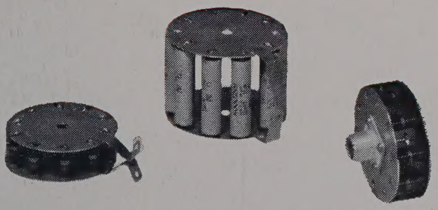

Fig. 13. Examples of parallel-connected resistors

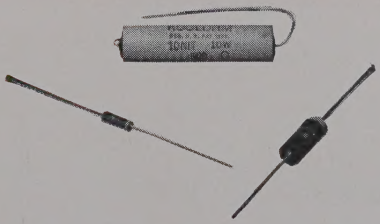

Fig. 15. Low-power resistor examples

five resistors, each set in a straight line, then connect one end of the two sets together. This brings the two leads of the composite resistor adjacent to each other. All leads in the series string should be as short as possible.

Dummy loads capable of handling 300 watts can be made from ten 10 watt non-inductive resistors. For a 50 ohm load, use ten 500 ohm resistors in parallel. For a 75 ohm load use ten 750 ohm resistors in parallel. For a 300 ohm load, use ten 3000 ohm resistors in parallel. All three combinations are usable to 150 megacycles if the units are paralleled as described before.

Dummy loads for powers above 300 watts can be made in a variety of ways. The best load, as indicated by a series of tests, is a series-parallel combination of 10 watt non-inductive wire-wound units. For example, ten 1500 ohm 10 watt resistors in parallel, connected in series with a similar unit, gives a 300 ohm load capable of handling 600 watts.

Higher wattage resistors can also be used, and tests have been run on all the resistors shown in the photographs. In general, it becomes increasingly difficult to make good dummy loads as the power requirements are raised. Non-inductive resistors with power ratings of 50, 100, 120 and 160 watt ratings have too much residual inductance to be used, singly, at frequencies higher than approximately ten megacycles, unless compensating capacitance is used in series with the resistors.

For example, a typical resistor with a residual inductance of two microhenrys requires a series capacitance of approximately 100 mmf at ten megacycles in order to be a "pure resistance."

Placing these larger-wattage resistors in parallel will decrease the effective inductance, but not sufficiently, unless a large number of them are so connected. They can be used singly, or in pairs, if you wish to "tune out" the series inductance by means of a series capacitance.

USING A DUMMY LOAD

There are a few precautions to be observed when connecting a dummy load to a source of power. One, make as direct a connection as possible, and use low inductance leads, such as copper straps.

Two, keep the dummy load away from metallic objects, in order to avoid an unbalance to ground. Three, keep the dummy load well in the clear so that adequate air circulation is assured.

FINAL NOTES

The information just given on non-inductive resistors is intended as a general guide to the selection of such resistors. Rigorous and complete tests are quite difficult to make, especially when a large variety of resistors is considered. Most of the data given was determined by the test arrangement shown in Fig. 11, which consists of a Millen grid-dip meter and an Eldico Antennascope. This sort of test permits a practical answer to be obtained quite easily.

The wire-wound resistors tested were made by Ward-Leonard, Sprague and Ohmite. These three companies have standard lines of non-inductive resistors which are readily available.

—*Lighthouse Larry*

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GEO. H. FLOYD, W2RYT—EDITOR

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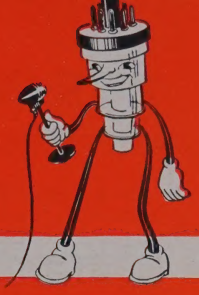

MARCH—APRIL 1951

VOL. 6—NO. 2

TVR HIGH-PASS FILTER

Effective, Economical 300-ohm Filter to Prevent Receiver Overload

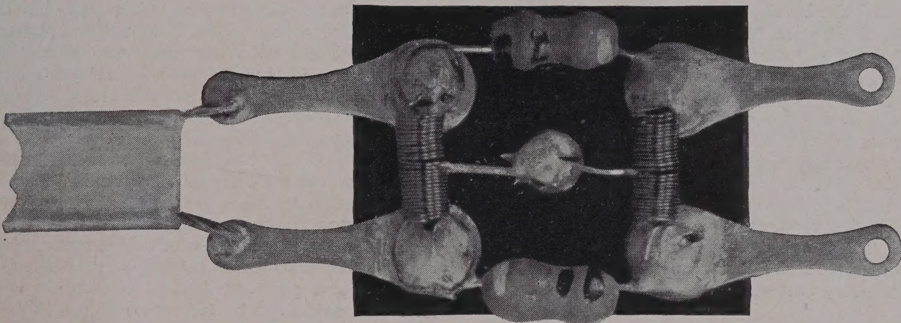

Fig. 1. Top view of the TVR Filter (shown 60% larger than full size). A short length of 300 ohm line is attached to give a better idea of the filter's actual size.

SEE PAGE 2 . . . . . .

UTILITY POWER SUPPLY

SEE PAGE 4 . . . . . .

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Utility Power Supply.......pages 4-5
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TVR HIGH-PASS FILTER

TVI eliminated from a TV set for less than half a dollar? The answer is very likely yes, but that's getting ahead of the story. The TVR filter does cost less than fifty cents, and may make you say, "Why didn't I think of that before?" but before any real claims are made let's see what it is and why it works.

The TVR filter is merely a balanced constant-K high-pass filter designed for 300 ohm transmission line. It should be used at the input to the television receiver where it is capable of greatly attenuating signals below 44 megacycles, and passing all television channel frequencies.

Why and when should it be used? That involves a little discussion.

THE TVI PROBLEM

The general problem of amateur radio interference to television receivers has been the subject of articles beyond number. The amateur who has not heard of TVI is either a hermit or else is rare DX residing in some far-away place where the mail boat seldom calls.

This intensive educational program on TVI is as it should be, and many fine articles have been written by the ham radio experts. Unfortunately, however, most of the emphasis on TVI elimination has been directed toward the harmonic-radiation problem. The result is that thousands of ham rigs are thoroughly covered with layers of shielding and use transmission line filters (see Ham News Vol. 4 No. 6).

All of this has been good and has been necessary, but many hams are still collecting stamps because the aforementioned precautions have not been sufficient.

Amateurs who have done an excellent job of reducing harmonic radiation still receive "legitimate" complaints that interference still exists. The cause of this trouble is the modern version of that old complaint, BCI. In our preoccupation with harmonic control we have lost sight of the possibility that other sources of difficulty can and do exist.

THE TV RECEIVER

Many modern television receivers will respond to strong signals on frequencies far removed from the frequency band to which they are tuned. Grid rectification (the big complaint in AC-DC broadcast sets) frequently exists. In addition, the TV receiver uses many sharp cut-off high-Gm tubes in order to obtain reasonable gain in the broad-band circuits. These sharp cut-off tubes simply won't take much extraneous signal without overloading. Further, these same tubes may also generate harmonics of a low-frequency amateur signal and thus produce their own interference.

So many possibilities of this sort exist in TV sets that it is not practical to make a complete list of them. Suffice it to say that the average TV set is wide open to signals of many frequencies, including fundamental amateur band frequencies. Reducing the strength of such signals by a filter placed at the antenna terminals of the television receiver will greatly reduce or eliminate the remaining interference.

PUBLIC RELATIONS

It is not the intent of this article to imply that the amateur is *responsible* for the installation of high-pass filters in his neighbor's TV receiver. Any TVI problem must be solved to the satisfaction of both parties. The best solution usually involves a judicious mixing of technical know-how and intelligent public relations.

Once you are convinced that your signals are clean and not at fault in any case of TVI, you are in an excellent spot to make a friend of your complainant. One tested approach is the demonstration approach. Ask the set owner for permission to make a simple demonstration, which does not involve going into his receiver.

When permission is granted, make the demonstration with the help of another amateur who will run your rig. The TVR Filter will reduce the interference and in most cases eliminate it. If one filter will not completely do the job, two in series certainly should.

After the demonstration, remove the filter (if the owner lets you), because you have only set out to demonstrate that something can be done. This is especially desirable if a serviceman has told the owner that nothing can be done to improve the receiver.

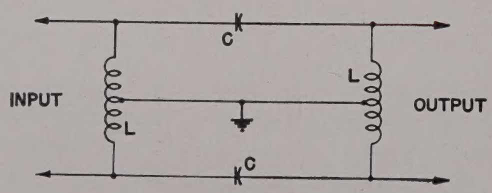
Of course, if the owner insists that such a filter be kept on his receiver—well, the rest must be obvious. Many owners insist on paying for the filter. Obviously, the most perfect filter in the world is useless if it is not attached to the receiver. A little tact will enable you to make a demonstration which ought to end the entire controversy.

ELECTRICAL DETAILS

The circuit diagram of the TVR Filter is shown in Fig. 2. There is absolutely nothing new in the design. It is a simple balanced constant-K high-pass filter with cut-off at 44 megacycles and a characteristic impedance of 300 ohms. In other words, it is used in 300 ohm lines, and attenuates all frequencies below 44 megacycles, yet permits the transmission of the television frequencies.

In cases where a television receiver uses a trans-

Electrical Circuit



CIRCUIT CONSTANTS

C . . . . . . 12 mmf general purpose ceramic condensers (Centralab .000012 mf Hi-Kaps are recommended.)

L . . . . . . 1.08 microhenry (28 turns No. 30 enamel wire. See text for coil winding details.)

Fig. 2. Circuit diagram of TVR Filter.

mission line of other than 300 ohms, the TVR Filter may be easily redesigned for the new impedance. The ARRL Radio Amateur's Handbook contains the design formulae for constant-K high-pass filters. It is recommended that the cut-off frequency be maintained at 44 megacycles.

It is possible to use more complex types of filters, but the majority of receiver overload problems can be cured by a simple filter, and the tough cases by two simple filters in series. Extremely severe cases may be better handled by means of highly complex (but more effective) high-pass or M-derived filters. For an exhaustive discussion of this class of filter the reader is referred to the article by W2RYI entitled "Design and Application of High-Pass Filters," which appeared in the Fall, 1950 *Ham Tips.*

CUT-OFF FREQUENCY

The selection of the cut-off frequency is an important one. If the frequency selected is too low, filter effectiveness is lost. If the frequency selected is too high, you may make a small error in coil winding and attenuate the lowest TV channel.

It is possible to specify a relatively high cut-off frequency for the TVR Filter because the coil-winding instructions, if followed carefully, allow very little room for error. However, it is not practical to use a cut-off frequency which excludes the six meter band. Therefore, the TVR Filter is not effective in reducing overload caused by six meter energy. Further, the two meter band is between two sets of TV channels so it cannot be taken care of by the TVR Filter.

In cases where interference from 50 or 144 megacycle transmitters is experienced, it is recommended that traps tuned to the band involved be inserted between the antenna and the TVR Filter. Tuned traps are discussed in the ARRL Radio Amateur's Handbook, and represent the most practical approach for these frequencies.

CONSTRUCTION

The "chassis" for the TVR Filter consists of a piece of insulating material 1 by 1¼ inches by $\frac{1}{16}$ inch thick. The material may be bakelite, lucite, etc. A piece thicker than $\frac{1}{16}$ inch may be used but this is unnecessary.

With reference to the photographs, five holes are drilled in the insulating material. Four of these are placed ¼ inch in from each corner and the fifth is in the exact center. Drill and tap each for a 4-40 machine screw. Brass screws are desirable.

Place a soldering lug under each corner screw and mount securely. Now solder the condensers in place between the two pairs of screws which are ¾ of an inch apart. Make certain that the solder flows over the head of the machine screw, thus bonding the screw to the lug. Make a ball of solder at this point.

Coil winding is next. Procure the No. 30 wire and cut off a piece approximately fifteen inches long. Fold it double. Remove the insulation carefully for a length of about one inch at the point of the fold. Tin and solder together the two wires at this point. Now lay this wire out straight with the tinned center at right angles to the length of the wire and measure out 6⅜ inches from this center point to each end. Cut the wire to this length. You should now have a straight piece of wire 12¾ inches long, not counting the length of the center-tap. Next, remove the insulation and tin the ends of the wire for a distance of ⅛ inch on both ends.

Procure a No. 30 drill (or a rod *exactly* ⅛ inch in diameter) and use this as the winding form. Start with one end of the wire and carefully wrap this wire around the solid (not the fluted) end of the drill until the entire coil is wound. Slip the coil off the drill, handling it with the stiff center-tap. Repeat for the second coil.

With tweezers turn out the tinned ⅛ inch length at each end, cut the center-tap to length, and solder the center-tap to the middle machine screw after tinning it. With the coil thus secured make a good solder joint with the end connections. Repeat for the second coil and you are almost finished.

Put nuts on the bottom side of the protruding machine screws, tighten carefully, and the TVR Filter is complete.

The coils are not as fragile as they might sound. Number 30 wire wound on a ⅛ inch diameter form has the same strength factor, wire diameter to coil diameter, as a coil wound with ⅛ inch tubing on a 1½ inch diameter form.

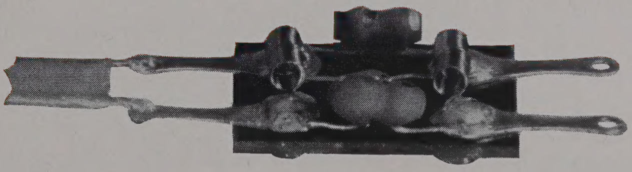
While it is a little less convenient to wind these coils on a ⅛ inch diameter form, it has been possible to eliminate the need for shielding by keeping the coils so small that direct pickup is negligible.

INSTALLATION

Attach the TVR Filter directly to the antenna posts of the television receiver. If a television booster is used, two TVR Filters should be employed. Place one at the receiver and one at the input to the booster.

In many cases no ground connection is necessary, or desirable, but if complete attenuation is not achieved try connecting the ground point on the TVR Filter with as short a lead as possible directly to the television receiver chassis.

Fig. 3. Oblique view of the TVR Filter.



UTILITY POWER SUPPLY

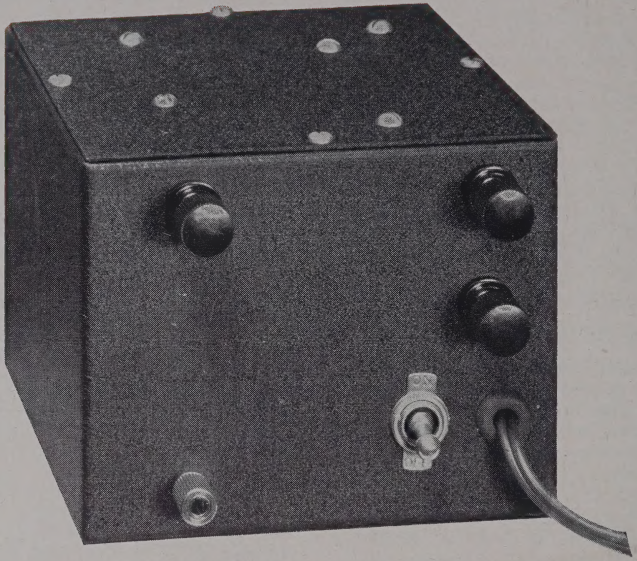


Fig. 4. Front view of the Utility Power Supply. High voltage connections on left, filament connections on the right

In doing experimental work around the shack there is nothing more convenient than a compact power supply which is capable of an output of 300 volts or so, especially if the same unit supplies 6.3 volts a-c for filament use. There are many ways to design such a power supply, but the supply about to be described has several advantages over the normal type of tube power supply.

Instantaneous output (no heat-up time required) is achieved by using selenium rectifiers. Further, a-c line isolation problems are avoided by use of an isolation transformer which also has a 6.3 volt winding. The result is a compact, cool-running, long-life power supply.

ELECTRICAL DETAILS

The complete circuit is shown in Fig. 6. The transformer specified is a Thordarson T-22R12 which has a 120 volt secondary (and a 120 volt primary) which is rated at a d-c current drain of 75 ma. This rating holds for both half and full wave operation. The circuit shown is a full-wave doubler circuit which will supply approximately 300 volts at 75 ma. This power is sufficient for receivers, low-power transmitters, and general experimentation. The filament circuit has a rating of 6.3 volts at 1.5 amps.

A filter is incorporated in the design so that external filtering is not required. The choke specified is rated at 80 ma which allows continuous operation without undue heating. The bleeder resistor is of a low enough value to drain the condenser charge quickly, yet is high enough in resistance that it does not take an appreciable current.

CONSTRUCTION

A standard 4 by 5 by 6 inch utility box houses the power supply quite nicely. If the layout shown in the photographs is followed, most of the wiring can be done before the box is put together.

All of the parts except the four binding posts, the a-c switch, R_2 and C_4 are mounted on one of the 5 by 6 inch removable sides. This side becomes the top of the power supply. Fig. 7 shows how the parts are placed. This photograph was made looking into the bottom of the power supply.

A two-point tie point is mounted at one end of the choke, and the junction of C_2 and C_3 connect here, as well as the junction of C_1 and R_1. Resistor R_1 is connected across the two points. The other ends of C_2 and C_3 connect to the selenium rectifiers, which are stacked so that adjacent terminals (a positive and a negative) may be connected together. The red terminal is the plus terminal.

In actual construction, mount and wire all parts on the 5 by 6 inch removable top and bring out 6 connecting wires—the a-c connections, the filament leads, and the d-c connections. Next, mount the binding posts, the a-c switch, and a rubber grommet on

LOAD CURRENT (ma)	OUTPUT VOLTAGE (VOLTS)
5	355
10	350
20	338
30	322
40	308
50	295
60	282
70	267
75	260

Fig. 5. Performance data for Utility Power Supply (110 volts on primary, filament winding fully loaded).

Electrical Circuit

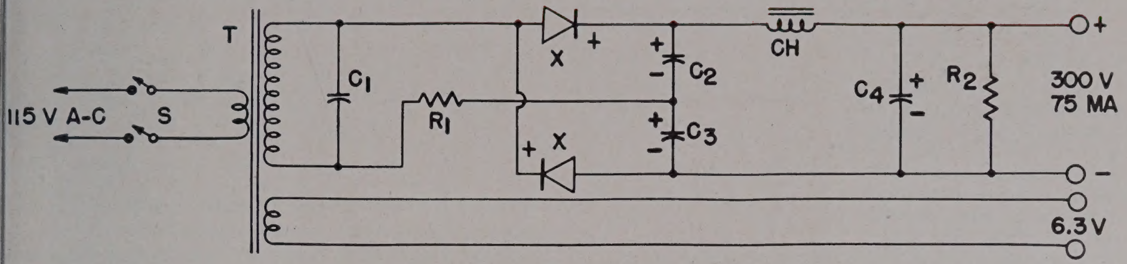


Fig. 6. Circuit diagram of the Utility Power Supply.

CIRCUIT CONSTANTS

C_1	0.01 mf 400 volt paper
C_2, C_3	40 mf 150 volt electrolytic
C_4	32 mf 450 volt electrolytic (two 16 mf units in parallel)
CH	12 Henry, 80 mil choke (Thordarson T-20C53)
R_1	25 ohms 1 watt
R_2	0.25 megohm 1 watt
S	DPST Toggle Switch
T	Power transformer, 120 volts at 75 mils, 6.3 volts at 1.5 amps. (Thordarson T-22R12)
X	75 mil selenium rectifier (G-E 6RS5GH1)

the front of the box. Condenser C_4, which is two condensers in parallel, connects across the d-c terminals, and the a-c cord is wired to the switch.

To assemble, place the top on the box, and solder the six loose wires to the proper points. Remember to use insulating washers when mounting the binding posts (except for the B minus terminal, which is grounded to the panel).

PERFORMANCE

The table in Fig. 5 indicates the voltage output versus load characteristic of the power supply. This data was taken with a line voltage of 110 volts, and with the filament winding delivering 1.5 amperes. The drop in voltage at high load currents is due primarily to the regulation characteristic of the selenium rectifiers.

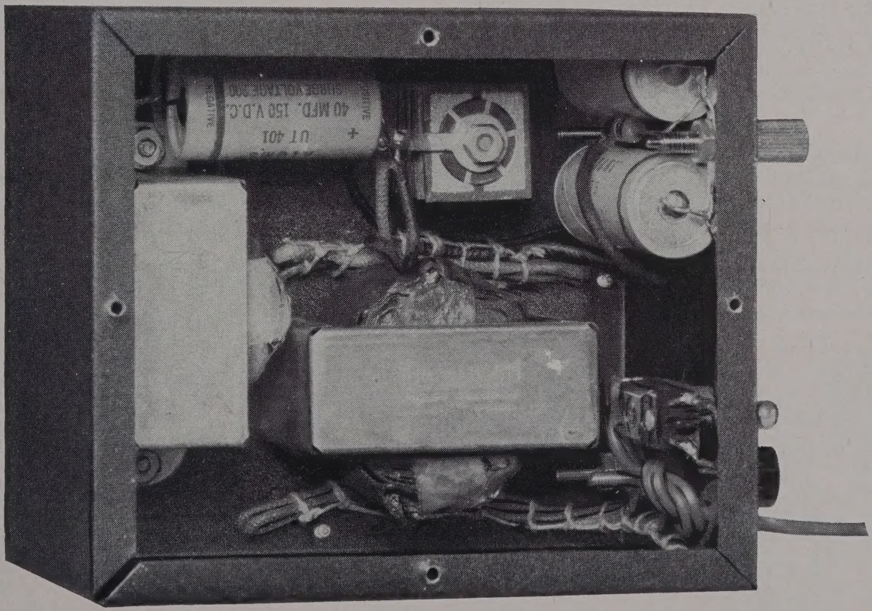


Fig. 7. Internal detail view of the Utility Power Supply.

How did you solve that last problem that almost had you stumped? Be it about tubes, antennas, circuits, etc., Lighthouse Larry would like to tell the rest of the hams about it. Send it in! For each "trick" published you win $10 worth of G-E Electronic Tubes. No entries returned. Mark your letter "Entry for Tricks and Topics" and send to Lighthouse Larry, Tube Division, Bldg. 269, General Electric Company, Schenectady, New York, or in Canada to Canadian General Electric Company, Ltd., Toronto, Ontario.

In the March-April 1949 Ham News, in the "Sweeping the Spectrum" column, I told of an idea of mine for placing nuts on inaccessible screws. The idea, briefly, involved placing the nut on an icepick, pressing the point of the icepick against the machine screw, then letting the nut slide down onto the screw.

Many other amateurs thought that my idea was all right, but they had better ones. Here are the results of their thoughts. Each amateur mentioned wins $10 worth of G-E tubes.—Lighthouse Larry.

Tricks & TOPICS

SOLDER VS. ICEPICK

One of my readers likes to use solder instead of an icepick. W3BIM suggests that I "replace the icepick with a piece of solder which is small enough in diameter to pass through the nut. Shape the solder for the path of the sliding nut so that it clears all obstructions."

BUS-BAR VS. ICEPICK

W8HAR uses a piece of bus-bar. He says, "The icepick idea is all right providing you have one small enough to pass your smallest size nut. I have found that a piece of bus-bar will accomplish the same thing and has the advantage that it can be bent to pass around parts which would interfere with the use of an icepick."

CUTTING THREADS IN SOLDER

W6AKQ, W6FYN and W9FPO all like to use solder in another manner. They suggest threading the solder into the nut so that the nut is held firmly, then snaking the solder down to the machine screw. Each has a slightly different slant on the subject.

W9FPO threads the nut onto a single piece of solder. W6FYN suggests bending the solder double so that the solder forms a tight fit in the nut (this is for 8-32 and 10-32 nuts).

The fanciest idea is given by W6AKQ, who writes: "Take a length of ordinary solder and flatten one end with pliers so that the width of the flat part is slightly larger than the diameter of the hole in the nut. Thread the nut onto the solder until one thread catches."

HAMMER AND PLIERS TECHNIQUE

Three of my readers like the brute force technique. Carl M. Retzlaff suggests holding the solder parallel with the nut and squashing the solder into the nut with a large pair of pliers. This squeezes the solder into a few of the threads and forms a strong joint.

VE3AZY does the same thing with a hammer: "Smartly rap with hammer so that solder is squashed into the first couple of threads."

W2ESO sent in a sort of history of ideas, including using glue to hold the nut to a dowel, and a magnetized tool, but he too ends up with "lay the solder across a nut and whack it with a hammer to expand the solder into the hole in the nut."

TWEEZER TECHNIQUE

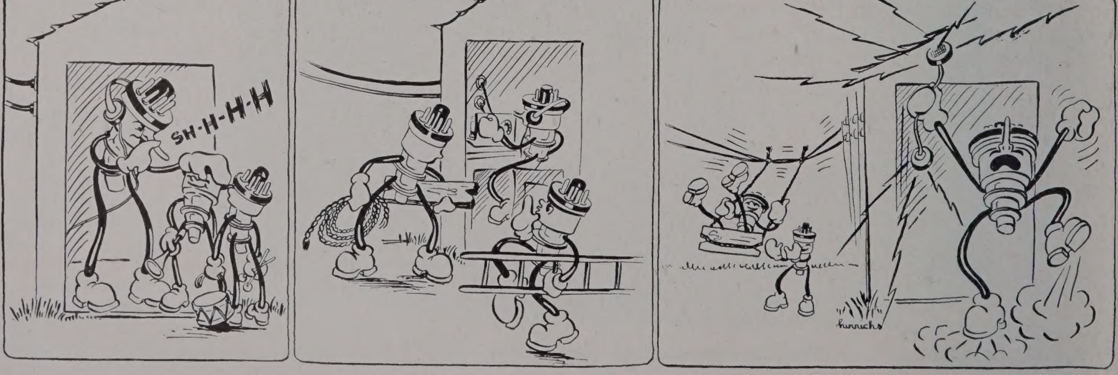
Commenting that my idea is perfectly all right if I have enough room, W6QIR goes on to say, "Use a pair of tweezers, placing the tips inside the nut and letting the spring of the tweezers hold the nut." He also points out that an ordinary match stick fits into a 6-32 nut snugly.

ADHESIVE TAPE TECHNIQUE

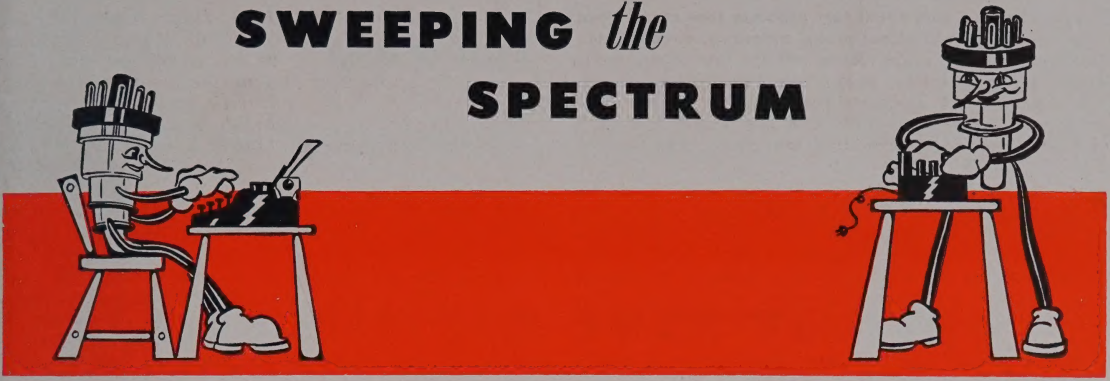
W0YSS has an entirely different approach. He suggests that the nut be put on first, and held by any sort of adhesive tape, either to the chassis or to the component being mounted. He prefers this to actually soldering the nut to the piece of equipment. If a hole is made in the tape to correspond to the screw hole, the nut will stay fastened while the screw is being tightened.

That's the story, from ten amateurs, on how to put a nut on a screw which is in an inaccessible spot. The only other answer seems to be—don't mount equipment so close to the edge of the chassis.

—*Lighthouse Larry*



SWEEPING *the* SPECTRUM



TVI is still a problem to the amateur but it should not be a major worry. It seems to me that sufficient information has been published to provide a solution for almost any case of TVI. If the solution is known, the problem can be solved. All it involves is some effort on the part of the amateur (even though, admittedly, it's not all his fault).

In many ways TVI problems are analogous to BCI problems. You old-timers will recall the trouble the 160-meter men had with BCI. Like so many things which seem so tragic at first glance, BCI turned out to be not so bad after all. Part of this was due to steps taken by the amateurs and part due to steps taken by radio receiver manufacturers.

It looks as though TVI is headed down the same path so that eventually TVI will be "that stuff we used to have back in nineteen-hundred and umpty-umph." Amateurs are doing their part to get clean signals, and TV set manufacturers are doing their part to produce receivers which are as little susceptible to interference as possible.

Don't forget, however, that inexpensive broadcast sets are still made and are the big cause of BCI, so that inexpensive television receivers may continue to be causes of TVI. On the whole, however, the outlook is much brighter.

* * *

Manufacturers are alert to this difficulty. General Electric Co., for example, recently announced the availability of an i-f band rejection filter for use with 300 ohm line. This filter (Stock No. RLW-008) is designed to greatly attenuate any signal in the frequency band between 40 and 47 megacycles.

It is built as an enclosed unit and requires no special mounting bracket, as it mounts by connection to the antenna posts of the receiver. The tuning of the filter is fixed and requires no adjustment when installed.

If you want further data on it, write to the Receiver Division, Electronics Dept., General Electric Co., Syracuse, New York.

* * *

If you want to be protected by the latest in electronic radar, take a ride on a city of New York ferry operating between Manhattan and Staten Island. All ferries on this run are now equipped with X-band electronic navigators.

It must be a good business deal to sell radar equipment to be used in ferry boats, because there are two "forwards" and two "afts," depending on whether you are going to Manhattan or Staten Island, so that two radar equipments are required.

Which brings up a point. If the captain told you to go up to the bow of the boat you would have to know which way the boat was going before you could comply.

* * *

Some night while you are resting from ham radio and enjoying television you may notice a white or black arrow flitting about on the screen. Don't tear your hair and rush about for a solution, because it may be the new Electronic Pointer (Type TV-34-A) recently developed by the Commercial Equipment Division of the Electronics Dept.

This device enables a narrator or commentator to insert a black or white pointer about 30 lines high and seven lines wide at any point in the TV picture, to more effectively describe the action taking place.

The equipment consists of a rack mounted chassis and a control unit which is similar to the control stick of an airplane. A toggle switch selects either a white or black pointer.

Can't you just visualize a ham TV QSO of 1970? "Now I'll just swing the ike on the rig and point out a few features of interest. Here is the final," says he, adroitly bringing the black pointer to bear on his new cavity tube, "and here . . . ."

—*Lighthouse Larry*

Designer's CORNER

Full-wave Transformer Design

Evidently some of my readers have started to scrutinize the nameplates on the surplus transformers they have purchased, because I have had several letters asking me to explain the ratings. The point that seems to produce the most confusion is the question of the power rating of primary and secondary.

For example, one full-wave transformer a reader asked me about had a rating of 0.222 KVA for the primary and a rating of 0.310 KVA for the secondary. How, he asked, can the secondary have a higher rating than the primary? How can you get more power out of a transformer than you put in?

These are good questions, and there is an exact answer to them, because the ratings stated are exactly correct. Let's see why. The following discussion applies only to single-phase transformers rated for full-wave rectifier service.

Assume a hypothetical problem. A transformer has a secondary with twice as many turns as the primary, and the secondary has a center-tap. Each half of the secondary winding is therefore identical to the primary winding. In operation in full-wave service one-half of the secondary winding is carrying current through a rectifier while the other half remains idle. On the succeeding half cycle of operation, the currents in the secondary windings reverse, and the formerly idle half carries current while the formerly active half remains idle.

This means that each half of the secondary winding must be capable of handling the full output current. Also, we assumed that each half of the secondary winding has the same voltage as the primary. Since this is true, it looks as though the volt-ampere rating of the total secondary should be *twice* the volt-ampere rating of the primary. This is almost true, but not quite, and the reason it isn't true is that the duty cycle of the secondary has not been considered.

In a transformer of the sort we are discussing, a winding is rated by a factor which is the square root of the length of time it carries current, divided by the total time. For one-half of the secondary this factor is therefore the square root of one-half, divided by one, which is 0.707. For the entire secondary this factor is multiplied by two, and so becomes 1.414. The primary factor is 1.000.

Therefore, all single-phase transformers designed for full-wave rectifier service should have a KVA rating for the secondary which is 1.414 times the KVA rating for the primary.

In terms of the d-c voltage and d-c current, the KVA ratings for the primary and secondary are as follows.

Primary KVA rating equals d-c current times d-c voltage times 1.11.

Secondary KVA rating equals d-c current times d-c voltage times 1.57.

—*Lighthouse Larry*

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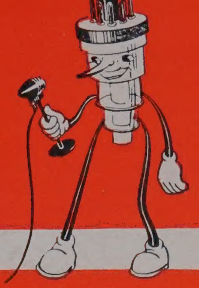
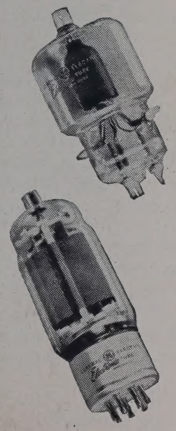


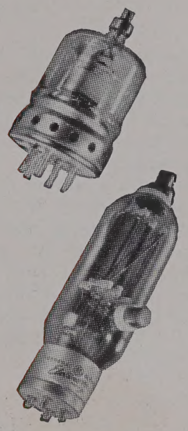
TRANSMITTER TUBE TESTING

Simplified Test Procedures for Popular Transmitting Tubes



TEST INSTRUCTIONS FOR:

GL-2E26
GL-4D21/4-125A
GL-4-250A/5D22
GL-35T
GL-100TH
GL-203A
GL-211
GL-592
GL-805
GL-806
GL-807
GL-810
GL-811A
GL-812A
GL-813
GL-814
GL-815
GL-829B
GL-832A
GL-837
GL-838
GL-8000
GL-8005



Whenever you suspect that a receiving tube is bad, you either plug in a new one (if you have a spare) or you make a trip to see your serviceman friend and use his tube tester. However, when something has gone wrong in your transmitter, you hesitate to try your spare transmitting tube in place of the suspect tube, and you certainly will not find a transmitting tube tester handy.

Or, if the ham in the next block wants to trade some tubes with you, you may end up with some low emission tubes that are good only for future trading with another unsuspecting ham.

All of the above points out the fact that it would be extremely nice to be able to test a transmitting tube when the need arises. It is the purpose of this article to explain how to run some simple (hence non-conclusive) tests on your favorite bottle.

GENERAL TESTING COMMENTS

Vacuum tube manufacturers spend a great deal of time and money in order to test their product completely. A transmitting tube such as the GL-813, for example, may have to pass twenty or more tests before it is considered good enough to bear the G-E trademark. Many of the individual test sets used to run these tests will each be worth more than an elaborate ham transmitter.

Obviously, therefore, any simple tests which the amateur is able to run will not do as complete a job of quality testing as the tests the manufacturers make. However, the simple tests about to be described will permit the ham to roughly evaluate the quality of his transmitting tubes, and in most cases, these simple tests will give a true indication of whether the tube is generally good or generally bad.

It is possible for these simple tests to call a bad tube good, and a good tube bad, especially if the tests are not carefully conducted, but these cases will be the exception, so the following simple tests should give you a wealth of information about the quality of your transmitting tubes.

TUBE TYPES CONSIDERED

Testing instructions are given for most of the popular and widely used amateur tubes (see list above). If a certain type is not included, it is either because the testing would be more complicated and

ontents

Transmitter Tube Testing .... pages 1–6
Sweeping the Spectrum .... page 7
R-F Power Indicator .... page 8

involve special apparatus; or, it is a high-power type not deemed necessary to include.

TEST INSTRUCTIONS

Three different tests are suggested for each tube type. The first is a short and continuity test, the second a static characteristic test, and the third either an oscillation test or a limited peak emission test, depending on tube type. It will be necessary to run all three tests in order to completely test any particular tube.

Run the tests in order. If a tube fails Test I because of an internal short, there is no point in making any further tests. However, if a tube passes Test I and fails Test II, you could still run Test III to see if the tube has any emission, even though Test II showed you that the static characteristic of the tube was poor.

If the tests are to mean anything, you must run them carefully. Use accurate meters. Follow the instructions exactly.

For tests II and III, allow the filament to heat for five minutes before proceeding with the test.

TEST I

The data for Test I is given on page 3. The purpose of this test is to determine filament continuity and to check for undesirable shorts. The base connection diagram for each tube is shown. These diagrams are made looking at the bottom of the tube, with the base pins facing you.

Use an ohmmeter to check continuity. *Do not* use a lamp in series with the a-c line as a continuity indicator, as you may damage the filament of the tube. An ohmmeter with a range of zero to 50,000 ohms or zero to 250,000 ohms, or anything in that range will be satisfactory. It is not advisable to use an ohmmeter scale which will read too high a resistance, such as ten megohms or so, because you are looking for continuity and shorts, and not for leakage.

Check for filament continuity first, then check for shorts by probing between a given pin and all other pins, then another pin against all other pins, etc. If a pin is marked NC, for no connection, check it anyway to make certain no continuity exists. All electrodes, including grid and anode caps (if any), should be tested for continuity or shorts.

Consider a tube to have passed this test if you have filament continuity, and continuity between other electrodes as shown on the diagram—and, if all other electrodes are floating, that is, have no continuity to any other electrodes.

TEST II

The data for this test is given on page 4. The purpose of this test is to determine, approximately, the static characteristic of the tube in question. In other words, it is a check on the controlling ability of the grid (or grids). This test is intended to show up a grid that has been bent out of place due to dropping a tube, for example. Many other small internal faults may also be determined. This test *does not* show whether a tube has low emission, or is near the end of life.

All tubes are not tested in the same manner. One group (Test II-A) must have the grid bias adjusted until the plate current measures a predetermined value, then the grid bias voltage must be read to determine if it falls in the "good" range. The other group (Test II-B) must have the grid bias voltage set to a certain value, then the resultant plate current must fall within a certain "good" range.

The circuit diagram for the test set-up is shown in Fig. 1 on page 4. If the tube you are testing has no cathode, disregard the cathode connection shown. Similarly, if the tube is a triode, disregard the dotted screen-grid lead. (One tube, the GL-837, requires a suppressor voltage. See note **B** on page 4.)

It is not necessary to construct a separate test set for Test II. You may use a socket in a rig you already have. Just remove, temporarily, the grid, screen grid and plate leads, and connect as shown in Fig. 1. It is desirable to be able to vary the filament voltage, so that it may be set exactly at the voltage specified in column 1, page 4.

To test a tube in the II-A group, apply filament voltage, apply a grid bias which is midway in the specified range, then apply plate voltage (and screen voltage if the tube is not a triode). Check the plate current and readjust grid bias until the plate current is as specified, then read the grid bias voltage you are using. The tube is "good" if the grid bias voltage is within the limits shown.

To test a tube in the II-B group, apply filament voltage, apply the exact grid bias voltage shown, and apply plate (and screen) voltage. Read plate current. The tube is "good" if the plate current is within the limits shown.

TEST III

The data for Test III-A is given on page 5, and that for Test III-B is given on page 6. Seventeen tubes are listed for the former test, and six tubes are more easily tested by the latter test. Test III-A is a power oscillation test, in which the tube is operating at 14 megacycles. Test III-B is a test which checks for the total emission, under the conditions shown, for a very brief moment.

The diagram on page 5 shows the test set-up necessary for Test III-A. This is a Hartley oscillator circuit. Because this test is run at a reduced filament voltage, it is absolutely necessary that a variable control be used in the filament circuit. This control need not be an autotransformer, as shown, but some sort of stepless control is needed.

In the circuit diagram for this test, the 0.005 mf condensers must have a voltage rating consistent with the tube being tested. They should be capable of handling the d-c plate voltage (E_B) plus some safety factor. The 0.005 mf condenser in the screen circuit should handle the d-c screen voltage (E_S), plus a safety factor. The two 0.002 mf condensers should be rated at 400 or 600 volts breakdown.

The tank coil should have an inductance of approximately 5 microhenrys. A regular 20 meter transmitting coil will serve, as long as the wire in the coil is bare, so that the proper point for the tap can be located.

If you already have a transmitter using the tube in question, it is not necessary to provide an oscillator circuit, as you may use the tube as an amplifier and run the test. In this case the tube must be run at as high a plate (and screen) voltage as specified, else the results will only be valid for the lower voltage you use.

To run Test III-A, put the tube in the circuit as shown, and turn on the filament, setting the control to give normal voltage. Make certain a dummy load is coupled to the tank, and apply plate (and screen) voltage. If the control grid current (I_C) is not as specified, adjust the tap on the coil (*with power off*) until the grid current is as specified.

Adjust the dummy load coupling (see *Ham News*, Vol. 6, No. 1, page 6 for a discussion of dummy loads), until the proper plate current (I_B) is being drawn, according to the table. Readjust the tap for proper grid current. Next, measure power output in some manner, and reduce the filament voltage until the power output drops down 10%. Read filament voltage. If this voltage is below the figure stated in column 7 on page 5, the tube is "good." If the voltage is more than the stated figure, the tube is "bad."

(Power output may be read in a comparative manner by the device shown on page 8.)

If a tube passes Test III-A, you know that the tube has some life left in it. The lower the filament voltage reading, the better the emission. This test will permit you to compare the emission of two tubes quite easily.

If you use your transmitter for the test set, Test III-A is run in a similar manner. Turn on the filaments, wait five minutes, then apply grid drive until I_C is as specified. Apply plate (and screen) voltage and adjust your dummy load until I_B is as specified. Measure power output, lower filament voltage until this power drops to 90% of the original value, then read filament voltage.

When running test III-A, watch the tube envelope. If a bluish glow appears which seems to fill most of the envelope, the tube is gassy and hence "bad." Under these circumstances, plate and screen currents may run extremely high.

Test III-B is a different sort of test, but it gives you approximately the same information as Test III-A. In Test III-B all electrodes except cathode (and/or filament) are connected together, then a positive voltage is applied to the electrodes, and the total current measured. Caution must be employed when running this test, as the grid will be damaged if the voltage is applied for more than a second or so.

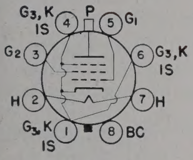
To run this test, connect the tube as shown in Fig. 3. Apply the filament voltage specified in column 1, page 6, and allow the filament to heat for five minutes. Make certain you are using the right plate voltage (column 2, page 6) then throw the switch. The instant the plate current meter settles down, make a mental note of the reading and turn the switch off. *Under no circumstances should the plate voltage be applied for more than four seconds.*

If the current for a new tube is greater than the value indicated in column 4, page 6, then the tube is "good." If the current for a used tube is greater than the value specified in column 3, page 6, then the used tube is "good." If I_T is below this last figure, the tube is "bad." Tubes which have total currents (I_T) which are approximately the same value have approximately the same emission.

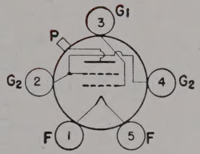
TEST I Continuity and Short Test

INSTRUCTIONS:

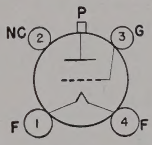
Use ohmmeter as discussed previously. Refer to proper diagram, below, and check for filament continuity, including filament or heater center-taps (if any). Check between other points where continuity should exist. Check the remainder of the pins, each to all others, to see if a short exists. Reject *tube if undesired shorts exist or if continuity is not found where it should exist.*


G3,K IS 4
P
5 G1
G2 3
6 G3,K IS
H 2
7 H
G3,K IS 1
8 BC

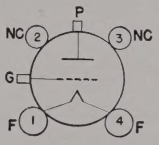
GL-2E26


3 G1
P
G2 2
4 G2
F 1
5 F

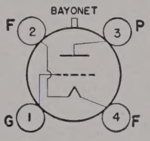
GL-4D21/4-125A
GL-4-250A/5D22


P
NC 2
3 G
F 1
4 F

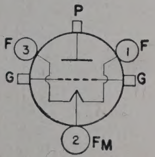
GL-35T


P
NC 2
3 NC
G
F 1
4 F

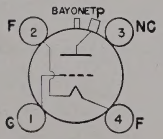
GL-100TH


BAYONET
F 2
P
3 P
G 1
4 F

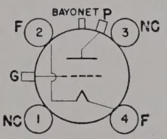
GL-203A GL-211
GL-838


P
F 3
1 F
G
G
2 FM

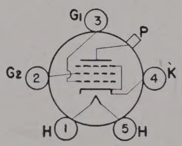
GL-592


BAYONET P
F 2
3 NC
G 1
4 F

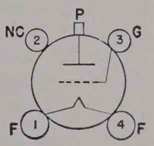
GL-805


BAYONET P
F 2
3 NC
G
NC 1
4 F

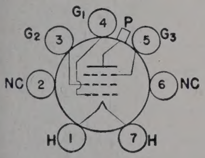
GL-806 GL-810
GL-8000


G1 3
P
G2 2
4 K
H 1
5 H

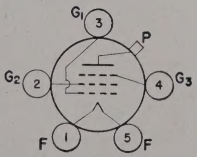
GL-807


P
NC 2
3 G
F 1
4 F

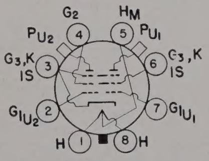
G-811A GL-812A
GL-8005


G1 4
P
5 G3
G2 3
NC 2
6 NC
H 1
7 H

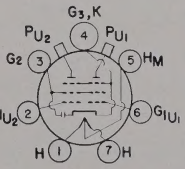
GL-813


G1 3
P
G2 2
4 G3
F 1
5 F

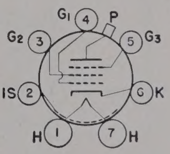
GL-814


G2
HM
PU2 4
5 PU1
G3,K IS 3
6 G3,K IS
GIU2 2
7 GIU1
H 1
8 H

GL-815


G3,K
PU2 4 PU1
G2 3
5 HM
GIU2 2
6 GIU1
H 1
7 H

GL-829B GL-832A


G1 4
P
G2 3
5 G3
IS 2
6 K
H 1
7 H

GL-837

KEY:

Bc—*Base Sleeve.* **F**—*Filament;* **Fm**—*Filament center-tap;* **G**—*Grid;* **H**—*Heater;* **Hm**—*Heater center-tap;* **Is**—*Internal Shield;* **K**—*Cathode;* **NC**—*No connection;* **P**—*Plate;* **S**—*Shell;* **U**—*Unit.*

TEST II Static Characteristic Test

IIA

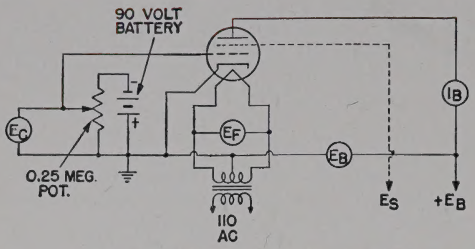


Fig. 1. Circuit diagram for static characteristic test set.

INSTRUCTIONS:

Apply filament voltage as shown in column 1; wait five minutes. Adjust grid bias to value half-way between those shown in column 4. Apply E_B and E_S. Readjust grid bias until I_B value is as shown in column 3. Read value of E_C on meter. Tube is "good" if this voltage falls inside the range indicated in column 4.

Column Number	1	2	3	4	5	6
Tube Type	E_F a-c volts	E_B d-c volts	I_B d-c ma.	$-E_C$ d-c volts	E_S d-c volts	Notes
GL-2E26	6.3	300	30	15/25	160	
GL-4D21/4-125A	5.0	1500	50	35/65	350	
GL-4-250A/5D22	5.0	2500	70	65/90	500	
GL-35T	5.0	1000	35	0/20	...	
GL-100TH	5.0	2000	40	20/50	...	
GL-806	5.0	1500	100	50/80	...	
GL-807	6.3	500	50	15/25	250	
GL-812A	6.3	1000	50	10/20	...	
GL-815	6.3	400	20	20/35	200	A
GL-829B	6.3	400	40	10/20	200	A
GL-832A	6.3	400	20	25/40	250	
GL-8005	10.0	1000	50	20/40	...	

IIB

INSTRUCTIONS:

Apply filament voltage as shown in column 1; wait five minutes. Set grid bias to value given in column 4, and apply E_B and E_S. Read I_B. Tube is "good" if this current falls inside the range of values indicated in column 3.

Column Number	1	2	3	4	5	6
Tube Type	E_F a-c volts	E_B d-c volts	I_B d-c ma.	$-E_C$ d-c volts	E_S d-c volts	Notes
GL-203A	10.0	1000	85/155	0	...	
GL-211	10.0	1000	55/85	50	...	
GL-592	10.0	2000	40/60	50	...	
GL-805	10.0	1500	60/100	0	...	
GL-810	10.0	2000	45/65	35	...	
GL-811A	6.3	1600	0/30	0	...	
GL-813	10.0	2000	35/65	35	400	
GL-814	10.0	1250	30/48	20	300	
GL-837	12.6	350	0/30	20	200	B
GL-838	10.0	1250	40/70	0	...	
GL-8000	10.0	2000	40/75	90	...	

NOTES:

A. For one section only. The grid of the section not being tested should be connected to the negative terminal of a 90-volt battery, and the positive battery terminal connected to the common cathode.

B. This tube requires a suppressor voltage during test. Connect +45 volts to the suppressor grid (pin 5). The negative voltage return goes to cathode (pin 6).

TEST IIIA 14 Megacycle Power Oscillation Test

INSTRUCTIONS: *Apply filament voltage as shown in Column 1. Wait five minutes. Apply plate and screen voltage (be sure dummy load is in place). If grid current is not as specified in column B, change tap on coil until value is correct. Change output coupling till plate current is as shown in column 5. Recheck grid current. Reduce filament voltage until output drops 10%. Read filament voltage. Tube is "good" if filament voltage is equal to or less than value shown in column 7.*

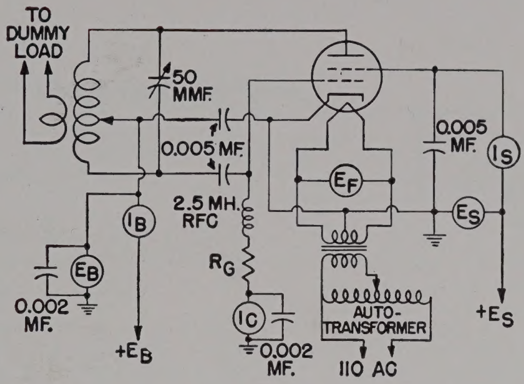


Fig. 2. Circuit diagram for power oscillator test set.

Column Number	1	2	3	4	5	6	7	8
Tube Type	E_F a-c volts	R_G ohms	I_C d-c ma.	E_B d-c volts	I_B d-c ma.	E_S d-c volts	E_M a-c volts	Notes
GL-4D21/4-125A	5.0	15,000	10	3000	100	350	4.5	
GL-4-250A/5D22	5.0	15,000	8	3000	200	500	4.5	
GL-35T	5.0	3,000	40	1500	120	...	4.5	
GL-100TH	5.0	4,000	50	3000	150	...	4.5	
GL-203A	10.0	5,000	25	1250	175	...	9.0	
GL-211	10.0	5,000	30	1250	175	...	9.0	
GL-592	10.0	5,000	45	3000	200	...	9.0	
GL-805	10.0	5,000	57	1500	210	...	9.0	
GL-806	5.0	10,000	50	3000	200	...	4.5	
GL-810	10.0	5,000	50	2000	250	...	8.8	
GL-811A	6.3	3,500	40	1500	150	...	5.7	
GL-812A	6.3	3,500	40	1500	150	...	5.7	
GL-813	10.0	10,000	12	2000	180	400	9.0	C
GL-814	10.0	8,000	12	1250	150	300	9.0	D
GL-838	10.0	5,000	55	1250	175	...	9.0	
GL-8000	10.0	8,000	38	2250	275	...	8.8	
GL-8005	10.0	5,000	35	1500	200	...	9.0	

NOTES:

C. Screen current on "good" tube should be between 25 and 55 ma.
D. Screen current on "good" tube should be between 15 and 30 ma.

Test IIIB Limited Peak Emission Test

INSTRUCTIONS:

Apply filament voltage as shown in column 1. Wait five minutes. Use battery indicated in column 2 for anode supply. Turn switch on and as soon as meter in anode circuit comes to rest, make a mental note of I_T and turn switch off. If switch is on for more than four seconds you may damage the tube. *A new tube is "good" if I_T is greater than the value indicated in column 4. A used tube still has some life left if I_T is greater than the value shown in column 3. Any value of I_T greater than that shown in column 3 indicates a usable tube.*

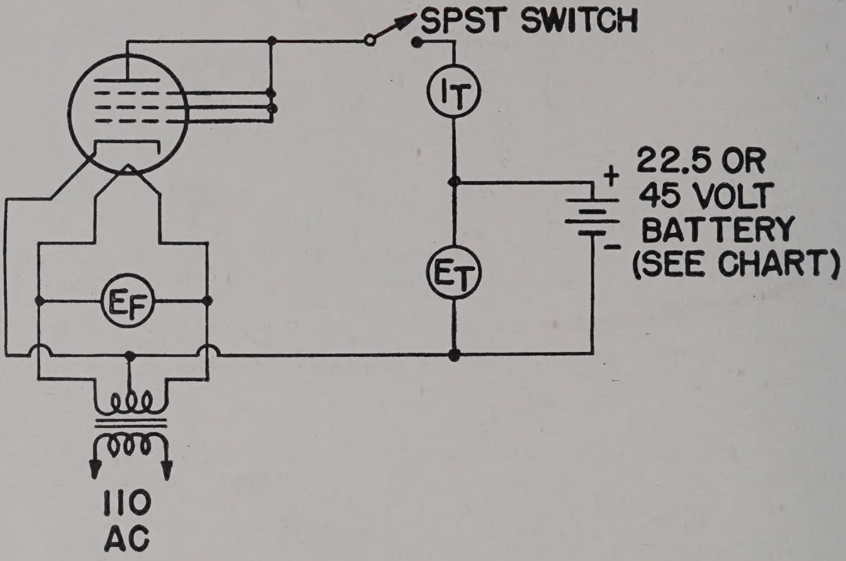


Fig. 3. Circuit diagram for limited peak emission test.

Column Number	1	2	3	4	5
Tube Type	E_F a-c volts	E_T d-c volts	I_T d-c ma.	I_T d-c ma.	Notes
GL-2E26	6.3	22.5	85	110	
GL-807	6.3	45.0	190	255	
GL-815	6.3	22.5	85	110	E
GL-829B	6.3	22.5	160	215	E
GL-832A	6.3	22.5	50	70	E
GL-837	12.6	22.5	65	85	

NOTES:

E. For one section only. The grid of the section not being tested should be connected to the negative terminal of a 90-volt battery, and the positive battery terminal connected to the common cathode.

SWEEPING *the* SPECTRUM

Good news on the G-E *Ham News* bound volume! By the time this issue appears the bound volume will be available. Those of you who sent in votes or comments on the bound volume should have received a personal note by this time stating that a copy has been set aside for you. The quantity bound will be sufficient to take care of all those who voted "yes" plus a few others who did not bother to vote. However, the edition is limited, and except for the volumes being held for those who voted, the rest will go out on a first-come, first-served basis.

Here are the details. The G-E *Ham News* Bound Volume is a cloth-bound book containing 214 pages. Included are all issues of the G-E *Ham News* from Vol. 1, No. 1, through Vol. 5, No. 6—that is, from the May-June 1946 issue to the November-December 1950 issue. The price of the book is $2.00, postpaid. Orders should be sent to Lighthouse Larry, Tube Division, Bldg. 267, General Electric Co., Schenectady 5, New York. Remittance (check or money order) should be made payable to General Electric Company. This offer applies only in continental U.S.A., Alaska and Hawaii. Be sure to include your name and address.

* * *

That wheeze about being sure to include your name and address is not just something to fill up space. You might be surprised if you knew how many letters I get in which the writer forgets to put his full name, or his address, or even his call. We even look on the envelope and are disappointed in some cases. If the call is included we are all set because we have a copy of the *Radio Amateur Call Book,* but without the call, or the address, there is nothing we can do but throw the letter away.

Also, if the name and address is typed, or printed, it is much easier to read. Some letters come in with a hand-written signature and address which we may not be successful in deciphering. Letters of this sort are the exception, of course, but you can help me to answer your letters if you remember to give your name and address so I can read it.

* * *

A *Ham News* reader recently wrote me and complained about the length of my address. He said that by the time he got through writing "Lighthouse Larry, Tube Divisions, Electronics Department, Bldg. 267, General Electric Company, Schenectady 5, New York" he didn't have any room in the letter to ask his question. I regret that my correct address is so lengthy, but there is a good reason for it.

The Schenectady plant of the General Electric Co. is the largest of its many plants. It covers an area about a mile long and slightly less than a mile wide. A good many people work in this area. As a matter of fact, G.E. has its own internal bus system, its own hospital, an efficient fire fighting department, several power generation plants, and even a truck system to distribute mail from building to building. It is really a city all by itself.

The mail system in our "city" must have my correct address, because I am not known personally to the mail clerks. If you are in a hurry when writing to me, you may use my shortest correct address, which is: Lighthouse Larry, Bldg. 267, General Electric Co., Schenectady 5, New York.

* * *

This issue of the *Ham News* starts off the sixth consecutive year of publication. The past thirty issues have brought you such items as the R-9'er, the Guillotine Converter, the Megabooster, the Single-Sideband Adapter, the Lazy Linear, the Harmoniker, the E-P Rig, the Logarithmic Compressor, the SSB, Jr. and the TVR Filter. It is your editor's hope that the next thirty issues will bring you at least as many ham hits.

Now under construction or in process of design are such things as a five-tube single-sideband receiver adapter, a specialized six-meter receiver, a versatile yet economical oscilloscope, and several other items which are still just doodles on the design board.

If you are interested in these units, be sure to get your copy of the G-E *Ham News* regularly at your nearest G-E Transmitting Tube distributor—or join our rapidly growing list of subscribers.

—*Lighthouse Larry*

R-F POWER INDICATOR

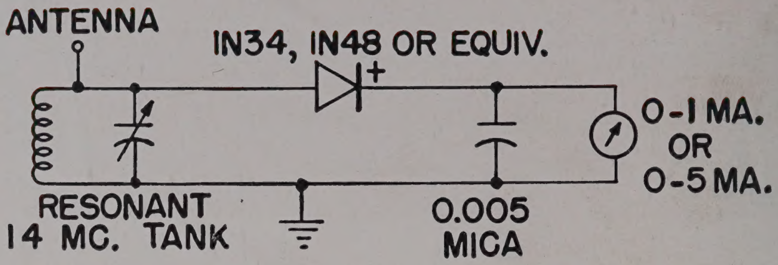


Fig. 4. Circuit diagram for germanium diode r-f power indicator. This unit is used in conjunction with Test III-A.

Fig. 4 gives the circuit diagram for a simple power output indicator to be used in conjunction with Test III-A. It consists of a tank circuit, a germanium diode, and a d-c milliammeter. As shown, this instrument will not give a quantitative power reading, but it will read percentage changes in power, which is all that is required for Test III-A.

The inductance and capacitance in the tank circuit is not specified because almost any values will serve as long as the combination will tune to 14 megacycles—the frequency of the test set. Either a 0–1 or 0–5 milliammeter may be used, because sensitivity is not too important.

Build the power indicator in a metal box. The ground connection shown in the circuit diagram does not particularly have to go to earth ground, but the metal chassis should be connected to the ground bus.

To use the instrument, place it as far from the transmitter as possible, in order that it picks up energy only from the test set (and not from driver stages, if they are used). Put an antenna on the indicator, and adjust the length of the antenna until the meter reads full scale. Now, when you wish to reduce the power by ten percent, lower the filament voltage in the test set until the meter reads 0.95 mils on the 0–1 milliammeter (or 4.75 mils on the 0–5 milliammeter). This current reduction represents a drop of ten percent in the output power of the transmitter under measurement.

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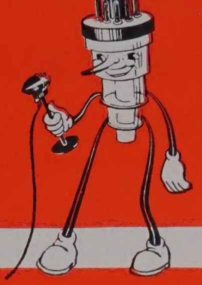

SIGNAL SLICER

Four Tube Receiver Adapter for Improved Reception of AM, NBFM, CW or SSB Signals

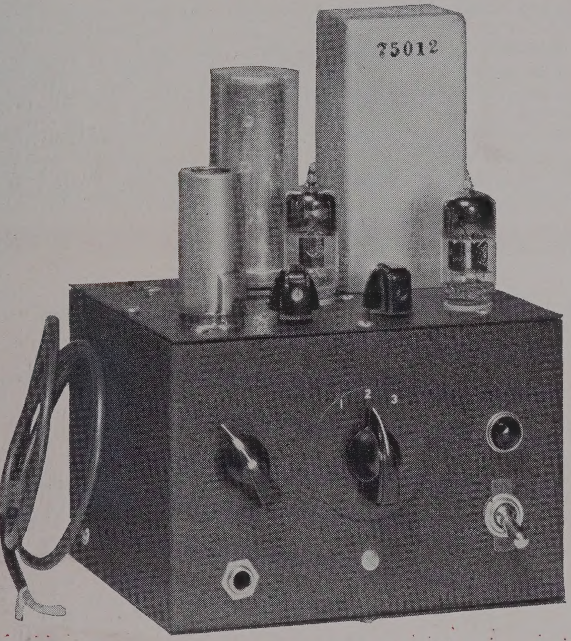

Fig. 1. Front view of the Signal Slicer. The input cable is at the left of the unit.

> *Ever since the SSB, Jr. transmitter appeared in the G-E* Ham News *my readers have been asking whether it would be possible to design a simplified receiver adapter incorporating the same simple phase-shift network. The Signal Slicer described in this issue is W2KUJ's answer to those questions.*
>
> —*Lighthouse Larry*

ANOTHER G-E HAM NEWS SSB SPECIAL

ontents

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SIGNAL SLICER

The Signal Slicer is a complete receiver adapter for converting the conventional communications receiver having 450–500 kilocycle I-F to a single-sideband receiver. The system utilized to obtain single-sideband response is of the phase-shift type, utilizing either a commercially made or a home-built phase-shift network of the type described for the SSB, Jr., transmitter (G-E *Ham News,* Vol. 5, No. 6). The name Signal Slicer has been applied to this adapter because of its ability to slice the selectivity curve of the conventional receiver in two, permitting one to listen at will to signals in either the upper or lower frequency portion of the receiver's normal I-F selectivity curve.

In contrast to the original SSB receiver adapter (G-E *Ham News,* Vol. 3, No. 6) the Signal Slicer requires no vacuum-tube probe, utilizes only four double-purpose tubes, and has no carrier synchronizing circuit. Notwithstanding a rather drastic reduction in its complexity, this adapter is a practical answer to the question, "Why not describe a simplified single-sideband receiver adapter?"

The Signal Slicer, when attached to a communications receiver, gives you a combination which permits you to do away with at least fifty percent of the QRM when receiving conventional AM or phase-modulated phone signals. The same holds true for the reception of CW signals, with the Signal Slicer supplying the heterodyning signal so that the BFO in the communications receiver is not required. True single-signal reception of CW signals is possible with this combination.

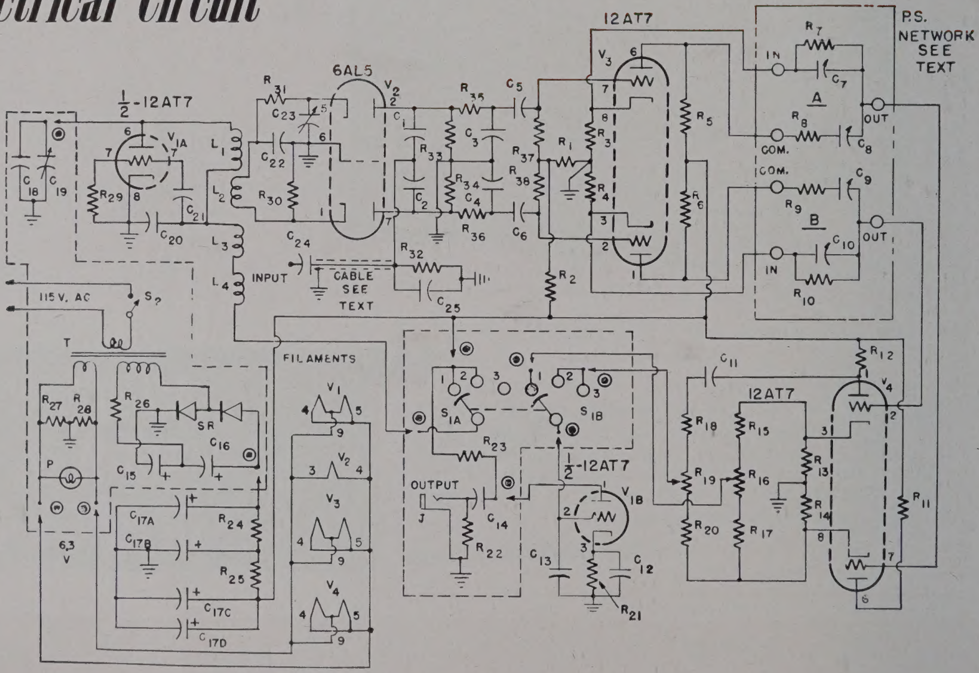
For reception of single-sideband signals, this adapter furnishes a carrier against which the sidebands may be demodulated. By selecting the proper sideband with a switch, the modulation may be read. Although it is now pretty well understood that a special adapter is not required for reception of single-sideband signals, many amateurs who have heard or used the original *Ham News* SSB receiver adapter appreciate the benefits of such a device.

CIRCUIT DESCRIPTION

The complete circuit diagram for the Signal Slicer is shown in Fig. 2. As is the case for most equipment described in the *Ham News,* an effort has been made to utilize completely standard components wherever possible. The built-in power supply is a conventional voltage doubler with a selenium rectifier and a conventional resistance-capacitance filter. No further comment on this portion of the circuit is necessary except to point out that a transformer is used to isolate the circuits from the a-c line in order to prevent interconnection problems between the adapter and the communications receiver.

The phase-shift type of adapter consists basically of two detectors (demodulators) supplied by a signal to be received and signals from an oscillator which acts as a local carrier source. The outputs of the

Electrical Circuit


½-12AT7
V1A
6AL5
V2
12AT7
V3
P.S. NETWORK SEE TEXT
IN
OUT
COM.
A
B
INPUT
CABLE SEE TEXT
115 V. AC
S2
T
SR
P
6.3 V
FILAMENTS
V1
V2
V3
V4
S1A
S1B
OUTPUT
J
½-12AT7
V1B
12AT7
V4
L1
L2
L3
L4
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
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C9
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C11
C12
C13
C14
C15
C16
C17A
C17B
C17C
C17D
C18
C19
C20
C21
C22
C23
C24
C25

Fig. 2. Circuit diagram of the Signal Slicer.

separate demodulators are fed through a pair of phase shifters of such characteristics that the algebraic sum of their outputs consists of audio signals created by I-F signals which lie on one side of the local oscillator frequency, and the algebraic difference consists of audio signals created by I-F signals which are on the other side of the local oscillator frequency.

In the Signal Slicer half of the double triode V_1 is used as a Colpitts oscillator whose output is coupled into the two halves of the double-diode V_2 acting as the two demodulators. These demodulators are also supplied with signals from the I-F amplifier of the receiver with which the adapter is used. The demodulator outputs are supplied to the double triode V_3 which in turn feeds two phase-shift networks (Millen No. 75012 or a home-made equivalent).

The outputs of the phase-shift networks are then applied to the two triode sections of V_4 whose outputs are fed to the combining circuits (R_{15}, R_{16}, R_{17} and R_{18}, R_{19}, R_{20}). These, in turn, feed through a selector switch into an audio amplifier, the remaining section of V_1. The purpose of the selector switch is to permit choice of sideband and to permit conventional receiver operation. With reference to the circuit diagram, positions 1 and 2 of switch S_1 are the two sideband positions, and position 3 is the proper position for normal operation of the receiver.

CONSTRUCTIONAL DETAILS

The Signal Slicer is simple to build, especially if a commercial unit is used for the phase-shift networks. The entire unit is built into a standard four by five by six inch utility box. Most of the components are mounted on one of the five by six inch removable cover plates. This plate will be referred to as the "top."

Refer to the circuit diagram, Fig. 2. Note that two groups of components are shown inside dotted-line boxes. The components that are in these two boxes are those that are mounted on the utility box proper. All the other components are mounted on the top plate, including the phase-shift network assembly which has been indicated in the circuit diagram inside a dashed-line box. This box is marked "P.S. Network." Don't confuse this with the two dotted-line boxes in the diagram.

It may be seen that each of the two dotted-line boxes has connection points indicated by a circle with a large dot inside. There are ten of these points. These represent the connections that must be made when the wiring of the box is complete and the wiring of the top plate is complete, and you are assembling the two sections. The leads shown with the arrow at each of these points indicate a length of wire which is left long so that the connection may be made after assembly. The photograph of the top plate in Fig. 3 shows these ten wires clearly. The wires are longer

CIRCUIT CONSTANTS

(All resistors and capacitors ±20% tolerance unless specified otherwise)

C_1, C_2	*100 mmf mica or ceramic (matched within 5%)*
C_3, C_4	*100 mmf mica or ceramic (matched within 5%)*
C_5, C_6	0.01 mf mica, paper or ceramic
C_7	*2430 mmf (0.002 mf mica ±5% with 170–780 mmf trimmer in parallel)*
C_8	*4860 mmf (0.0043 mf mica ±5% with 170–780 mmf trimmer in parallel)*
C_9	*1215 mmf (0.001 mf mica ±5% with 50–380 mmf trimmer in parallel)*
C_{10}	*607.5 mmf (500 mmf mica ±10% with 9–180 mmf trimmer in parallel)*
C_{11}, C_{14}	0.1 mf 400 volt paper
C_{12}	0.5 mf 200 volt paper
C_{13}, C_{25}	470 mmf mica or ceramic
C_{15}, C_{16}	40 mf 150 volt electrolytic
$C_{17A, B, C, D}$	20—20—20—20 mf 450 volt electrolytic
C_{18}	*300 mmf mica ±5%, for 456 to 465 KC. (Use 240 mmf for 500 KC, I-F receivers)*
C_{19}	50 mmf variable (Hammarlund HF-50)
C_{20}	*0.003 mf mica ±10%*
C_{21}	1000 mmf mica or ceramic
C_{22}	*330 mmf mica ±5%*
C_{23}	5–50 mmf mica trimmer (El Menco T-52210)
C_{24}	10 mmf mica or ceramic
J	Open circuit jack
L_1, L_2, L_3, L_4	All made from one R-F choke (see text)
R_1	*10,000 ohm, ½ watt (±10%)*
R_2	*680,000 ohm, ½ watt (±10%)*
R_3, R_4	*2,000 ohm, ½ watt precision (±1%)*
R_5, R_6	*7,000 ohm, ½ watt precision (±1%)*
R_7, R_{10}	*133,300 ohm, ½ watt precision (±1)%*
R_8, R_9	*94,000 ohm (100,000 ohm ½ watt ±1% precision resistor in parallel with a 1.5 megohm ½ watt ±5% resistor)*
R_{11}, R_{12}, R_{13}, R_{14}	*3,000 ohm, ½ watt (±5%)*
R_{15}, R_{17}, R_{18}, R_{20}	*220,000 ohm, ½ watt (±10%)*
R_{16}, R_{19}	100,000 ohm potentiometer
R_{21}	*5,600 ohm, ½ watt (±10%)*
R_{22}	2.2 megohm, ½ watt
R_{23}	47,000 ohm, 1 watt
R_{24}, R_{25}	470 ohm, 1 watt
R_{26}	*400 ohm, 4 watt (±10%) (Two 200 ohm, 2 watt resistors in series)*
R_{27}, R_{28}	47 ohm, ½ watt
R_{29}, R_{32}	10,000 ohm, ½ watt
R_{30}	*1,000 ohm, 1 watt (±5%)*
R_{31}	*1,000 ohm, ½ watt (±10%)*
R_{33}, R_{34}	*1.0 megohm, ½ watt (±10%)*
R_{35}, R_{36}	*51,000 ohm, ½ watt (matched within 5%)*
R_{37}, R_{38}	*3.3 megohm, ½ watt (±10%)*
S_1	Double pole, three position shorting type rotary switch
S_2	SPST Toggle Switch
SR	Voltage doubler type selenium rectifier, rated 160 RMS volts at 100 ma (Federal 1008A)
P	6.3-volt pilot lamp
T	Power Transformer, 135-volt A-C RMS secondary at 75 ma, 6.3 volts at 1.5 amps (Thordarson R-22R12)
P.S. Network	Millen No. 75012 or home-made equivalent (see text)

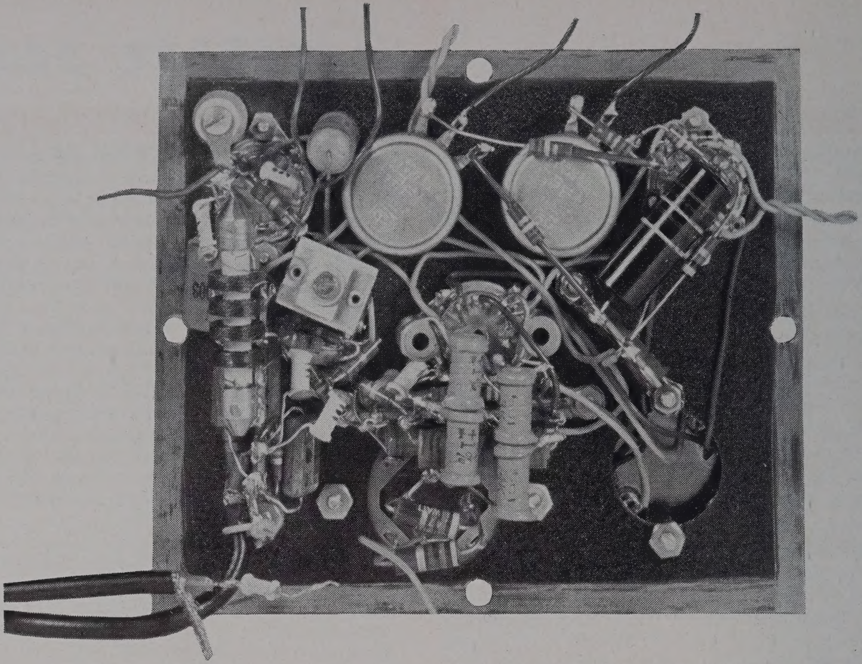


Fig. 3. Detail view of the wiring on the top panel of the Signal Slicer.

than the photograph shows. Make each one about 5 inches long, then cut them to length when assembling the adapter.

A drilling layout is shown in Figs. 6, 7 and 8 for those who wish to duplicate the original unit exactly. If another type of construction appeals to you, a reasonable duplication of the layout shown is suggested.

With reference to Fig. 4, the power transformer, the selenium rectifier, condensers C_{15}, C_{16} and resistor R_{26} are mounted on the rear apron of the utility box. This rear apron also has two grommets mounted on it to handle the a-c line and the input probe cable. On the front apron you mount the pilot light, power switch S_2, resistors R_{27}, R_{28}, oscillator tuning control C_{18}, C_{19}, output jack, selector switch S_1, condenser C_{14} and resistors R_{22} and R_{23}. All the wiring involved with these components can easily be completed if the two removable plates are not in place. Because of tolerances on certain components and the particular I-F of your receiver, it is well to mount C_{18} directly across C_{19} so that possible pruning operations may be done conveniently without removing the top plate.

The one inch diameter hole specified for the phase-shift network is used regardless of whether a Millen unit or a home-made unit is employed. Details of the home-made unit will be given later.

It is desirable to remove the paint from the top lip of the utility box, and from the four edges of the top plate, to ensure good electrical contact when the two parts are joined.

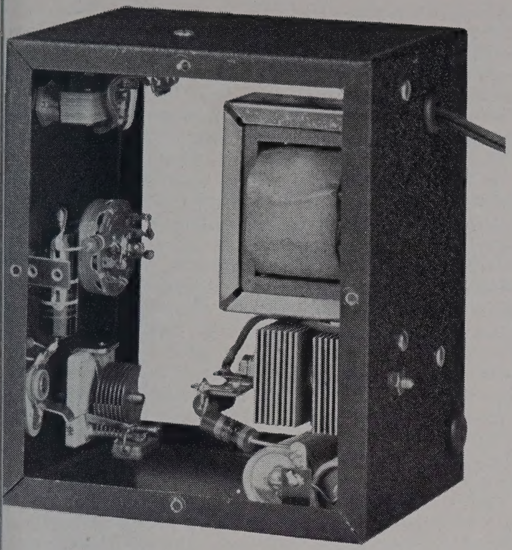
Coils L_1, L_2, L_3 and L_4 require explanation. All four coils are made by making some minor changes on a single National R-100 R-F choke. This choke has four pies, and each pie becomes a coil. To make the necessary changes, refer to Fig. 5, and proceed as follows. Examine the coil and the individual pies. You will note that one lead on each pie comes off the outside of the pie, and the other lead comes from the part of the pie nearest the ceramic support. Orient the choke in your hand until it is as shown in Fig. 5, that is, so that the lead from the right-hand end goe to the outside of the farthest-right pie, L_1.

Carefully loosen two turns on the outside of L_2 anc then cut the wire to provide an inch or so of lead fron the inside of coil L_1. Remove the insulation and th enamel from the end of this lead. The two connections to coil L_1 are now the original pigtail and th inch or so of wire removed from the outside o coil L_2.

Repeat this operation on coil L_3 to provide lead for coil L_2, as well as a connecting lead from L_3 t L_1. Continue as shown in Fig. 5 until you have L_1 i series with L_3 and L_4, with L_2 having separate, unconnected leads. Tin the ends of all wires and solde the connection between L_1 and L_3. Double-check t make certain that your leads are as shown in Fig. 5 that is, that the leads come from the top of the pi where so indicated and from the center of the pie where so indicated. This is important, because thi determines the direction of the winding on the form The entire procedure probably will take less time t do than the time you have spent reading this. Th inductance of each pie of the National R-100 chok is approximately 420 microhenries.

For wiring details of the top of the Signal Slicer refer to Fig. 3. The coil assembly (L_1 through L_4) i mounted with the L_1 end fastened to a ceramic standoff post and the other end connected to one lug of terminal strip. The common connection of L_1 anc L_3 should be made to the end lug of the terminal stri nearest V_1, and the two connections from L_2 to th next two lugs. Make certain that the coil will clea the lip on the box as the chassis is mounted. Th remainder of the wiring is quite straightforward anc should present no difficulty. Note that R_5 and R_6 ar actually each made up of a 3000 and a 4000 ohn resistor in series, since 7000 ohm resistors were no immediately available.

Remember to leave several inches of hookup wir at each of the ten connection points, so that the fina assembly consists in cutting these wires to length anc



. 4. **Detail view of the completely wired interior of Signal Slicer.**

soldering them to the proper points on the box proper. Obviously, all wiring should be completed on the top plate before the final connections to the box are made. The probe cable should be made of approximately two feet of RG-58/U cable, and C_{24} soldered to the far end. The cable may be shorter or longer, but try to keep its length under six feet.

PHASE SHIFT NETWORKS

The Millen No. 75012 network is a complete and aligned pair of phase-shift networks. To use this unit in the Signal Slicer a slight modification is required to achieve optimum results. Each of the 100,000 ohm precision resistors (R_8 and R_9 in the circuit) should be paralleled with a 1.5 megohm five percent tolerance ½ watt carbon resistor. To do this the can must be taken apart to permit access to the resistors. The photograph (Fig. 9) shows where these resistors have been added to the Millen unit. Make no other changes or adjustments, since these units are pre-aligned at the factory.

The change mentioned is beneficial in taking account of the effective source impedance presented by V_3 and associated circuits.

If desired, you may make your own phase-shift network unit. The home-made unit pictured in Figs. 10 and 11 is made in a Millen No. 74400 plug-in shield can. The octal base pictured is a part of this unit. The components are supported on a vertically-mounted piece of insulating material, such as bakelite, poly, etc. The size of this piece is 3⅝ by 1¾ inches by $\frac{1}{16}$ inch thick. This is secured to the mounting posts by two small right-angle brackets. The suggested terminal arrangement is pictured quite clearly in Figs. 10 and 11. The fixed mica condensers are mounted on one side of the insulating material, and the adjustable trimmers and resistors on the other side. Mount, but do not solder these components in place until the phase-shift networks have been aligned.

The suggested pin connections for a home-made unit are as follows: Pin 1, ground; pins 2, 3 and 4, network "A"; and pins 6, 7 and 8, network "B."

Electrically the two networks in this can are identical to the ones used in the **SSB**, Jr., except for the modification noted above for the Millen unit. (For convenience, the symbol numbers indicated in Fig. 2 in this issue are the same as were used in Figs. 2 and 3A of the Vol. 5, No. 6, *Ham News* describing the SSB, Jr.)

After completing the phase-shift unit leave the can cover off until the adjustments are made and the two 1.5 megohm resistors added across R_8 and R_9. Run a wire from pin 1 on the phase-shift unit to one of the mounting posts inside the No. 74400 can to allow grounding. To prevent inadvertent short circuits, a stiff piece of insulating material (such as waxed Kraft paper) should be placed inside the can as is usually done in commercial I-F transformers.

If a home-made phase-shift network is used, an octal socket will be required on the top plate to accommodate the Millen No. 74400 unit. The alignment of the home-made phase-shift network will be discussed later.

COMPONENT PARTS

As is true with many equipment designs, there are some component parts in the Signal Slicer that must be chosen carefully. The precision resistors specified are important if optimum results are to be obtained. Continental "Nobleloy" 1% resistors were used in the original models of the Signal Slicer (where 1% resistors are specified) although any other make of equal quality should work equally well.

Some of the other resistors are specified with tolerances of 5% or 10%. This has been done to ensure a piece of equipment which will be capable of being tuned up properly after you complete it. If you desire, use 20% tolerance resistors which you have measured to make certain that they are within the required tolerance. Certainly one or two of these values may vary as much as 20%, but if all the resistors varied this much, in the wrong direction, you might have a much harder job getting the unit to work properly.

The adjustable mica trimmers used in the phase-shift networks may be any good grade of trimmer. Those actually used are El Menco: T52910 for C_7 and C_8; T52510 for C_9; and T52310 for C_{10}.

It is important that you use a National R-100 2.5 mh. choke for L_1, L_2, L_3 and L_4. Other chokes will undoubtedly work, but the National R-100 is universally available, and no attempt was made to check the suitability of other four-pie 2.5 mh. chokes.

Mica condensers should be used where mica only is specified. In the other cases the specifications call for "mica or ceramic" or "mica, ceramic or paper" condensers. In general, the ceramic condensers are smaller than either the mica or paper condensers and should therefore be used if feasible. Be certain to obtain condensers within the tolerances specified.

The selector switch, S_1, should be of the shorting type. Loud switching transients will be produced unless this precaution is observed.

The selenium rectifier specified is capable of handling 160 volts RMS. Most small selenium rectifiers are rated for only 130 volts RMS, and these were not specified because the transformer, unloaded, supplies more than 130 volts RMS, which would damage the lower-rated rectifier.

CIRCUIT ADJUSTMENTS

With the exception of alignment of the phase-shift networks (if you build your own) very few adjustments are required in the Signal Slicer. The two

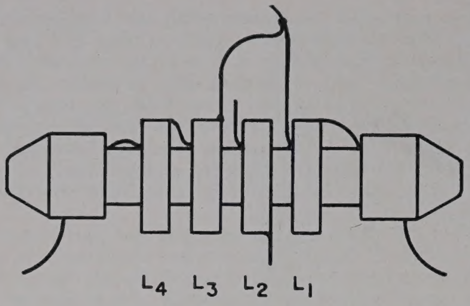


Fig. 5. Sketch of the altered R-100 choke

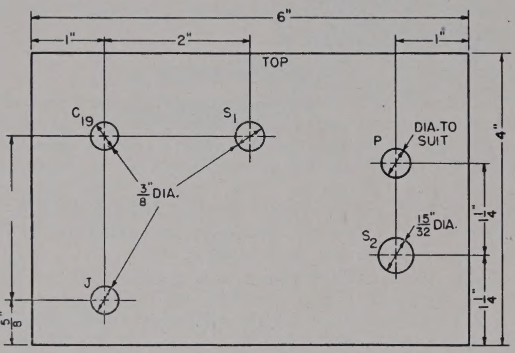

6"
1"
2"
1"
TOP
C_{19}
S_1
DIA. TO SUIT
P
$\frac{3}{8}$" DIA.
$\frac{15}{32}$" DIA.
S_2
J
4"
$1\frac{1}{4}$"
$1\frac{1}{4}$"
$\frac{5}{8}$"

Fig. 6. Layout dimensions for the front of the Signal Slicer. The dimension on the left which is blank should be 1 ⅝ inches. Note also that the holes for C_{19} and S_1 are not shown in true perspective, because they are actually closer to the bottom of the panel than the hole for the panel light. The dimensions shown are correct.

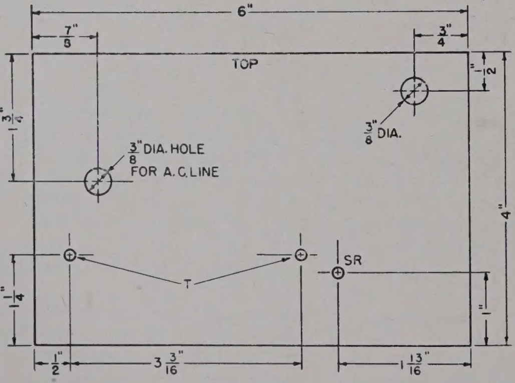

6"
$\frac{7}{8}$"
$\frac{3}{4}$"
TOP
$\frac{1}{2}$"
$1\frac{3}{4}$"
$\frac{3}{8}$" DIA.
$\frac{3}{8}$" DIA. HOLE FOR A.C. LINE
4"
SR
T
$1\frac{1}{4}$"
1"
$\frac{1}{2}$"
$3\frac{3}{16}$"
$1\frac{13}{16}$"

Fig. 7. Layout dimensions for the rear of the Signal Slicer.

methods for alignment of the home-made phase-shift networks are identical to those described for the SSB, Jr. The simpler method is to use accurately measured parts (R_7 through R_{10} and C_7 through C_{10}). The more exact method involves four test frequencies which enable one to adjust each of the four capacitors, C_7 through C_{10} for perfect alignment.

The adjustment procedure using the test frequencies is as follows. First, determine that the resistors R_7 and R_8 (as well as R_{10} and R_9) bear the ratio of 133,333 to 100,000, that is, 4 to 3, as closely as can be determined. If there is any doubt about the value of the resistors, double-check their values on an accurate bridge. Next procure the two necessary instruments, which are an audio oscillator capable of providing output frequencies in the range between 300 and 2000 cycles per second, with good waveform, and an oscilloscope. The oscillator may be calibrated by the method described later. Connect the oscillator output through a step-down transformer (a conventional audio transformer run "backward" will do nicely) into a 1000 or 2000 ohm potentiometer with the arm of the potentiometer grounded. See Fig. 12.

Adjust the arm position so that equal (but opposite) voltages appear on each half of the potentiometer. A steady audio frequency signal of any convenient frequency may be used with an oscilloscope acting as a convenient voltmeter for this job. Swing the vertical deflection lead from one end of the potentiometer to the other and adjust the arm to obtain equal voltages (a true center-tap). Set up a temporary double cathode-follower circuit using a 12AT7 with 500 ohms from each cathode to ground and connect as shown in Fig. 12. (It will be convenient to provide leads M, N, and 1 and 2 with clips at the ends to facilitate checking.) The horizontal and vertical plates of the oscilloscope should be connected to the 12AT7 cathodes as shown in Fig. 12 and the 'scope common connection should go to the arm of the potentiometer.

Now, refer to the circuit diagram, Fig. 2, and disconnect the elements in your home-made phase-shift network as follows. Disconnect the left-hand end of

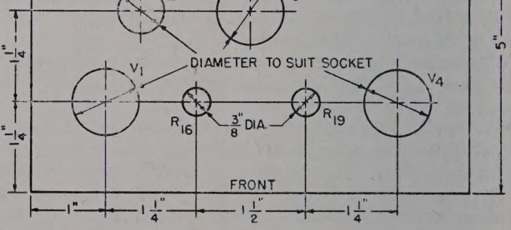

6"
$2\frac{5}{8}$"
$1\frac{1}{4}$"
REAR
C_{17}
1"
$1\frac{1}{4}$" DIA.
1" DIA.
$1\frac{1}{4}$"
MILLEN 75012
$1\frac{1}{2}$"
$1\frac{1}{2}$"
V_2
V_3
5"
$1\frac{1}{4}$"
DIAMETER TO SUIT SOCKET
V_1
V_4
R_{16}
$\frac{3}{8}$" DIA.
R_{19}
$1\frac{1}{4}$"
FRONT
1"
$1\frac{1}{4}$"
$1\frac{1}{2}$"
$1\frac{1}{4}$"

Fig. 8. Layout dimensions for the top panel of the Signal Slicer.

R_7 from C_7. Disconnect the left-hand end of R_{10} from C_{10}. You are now ready to proceed with the alignment.

Connect lead M (Fig. 12) to the left-hand end of R_7 and connect lead N to the left-hand connection of C_7. Connect leads 1 and 2 (Fig. 12) to terminal M. Adjust the horizontal and vertical gains on the oscilloscope to produce a line about 1½ inches long slanted at 45 degrees when the oscillator is set to a frequency of 490 CPS. If the oscilloscope has negligible internal phase shift the display will be a straight line instead of a narrow slanting ellipse. If the latter display appears it is necessary to correct the oscilloscope phase shift externally by using an adjustable series resistance (a 50,000 ohm potentiometer) mounted at either the vertical or horizontal input terminal, depending on what correction is necessary.

At any rate, the objective here is to get a straight line at 490 CPS. In some cases a series capacitor may be needed to provide the necessary correction. Try values from 0.05 to 0.0005 mf. Now shift lead 1 from the left-hand end of R_7 to the junction of R_7 and C_7. Adjust the trimmer of C_7 to obtain a circle on the oscilloscope. It will be noted that as this adjustment is made the display will shift from an ellipse "leaning" to one side through a circle or ellipse (with axes parallel to the deflection axes) to an ellipse which leans the other way. If desired or necessary, the appropriate gain control on the oscilloscope may be changed so that a circle instead of a "right" ellipse is obtained at the point of correct adjustment. After changing the gain control on the oscilloscope, check (and correct, if necessary) the phase shift in the oscilloscope by moving lead 1 back to the left-hand end of R_7, and then repeat the setting of C_7 with lead 1 back again on the junction of R_7 and C_7.

In general, always make certain that the oscilloscope is used in a phase-corrected manner. As a double-check (if the deflection plates in the 'scope are skewed, for instance) connect lead 2 to the left-hand end of C_7. If the circle changes to a slanting ellipse, readjust C_7 to produce an ellipse half-way between the ellipse (obtained by switching lead 2) and a circle. Changing lead 2 from the left-hand end of C_7 to the left-hand end of R_7 and back again should give identical skew to the display when C_7 is set correctly. Failure to get symmetrical ellipses (egg-shaped, or other display) is due to distortion, either in the oscilloscope, the oscillator, the transformer, or the cathode follower. Conduct the test at as low a signal level as possible to avoid distortion.

Next, connect lead M to the left-hand end of R_{10} and lead N to the left-hand end of C_{10}. Connect leads 1 and 2 to lead M, set the oscillator frequency to 1960 CPS, correct 'scope phase-shift as before, and move lead 1 to the junction of C_{10} and R_{10}. Adjust C_{10} for a circle as was done for C_7, using the precautions outlined for that case.

Now connect lead M to the left-hand end of R_9 and lead N to the right-hand end of C_9. Connect leads 1 and 2 to lead M, set the oscillator frequency to 1307 CPS, correct 'scope phase-shift as before, and move lead 1 to the junction of R_9 and C_9. Adjust C_9 to obtain a circle on the oscilloscope, as before.

Repeat the above procedure for the remaining R-C pair, R_8 and C_8. Use an oscillator frequency of 326.7 CPS. This completes the alignment of the phase-shift network. None of the preceding alignment instructions need be carried out if a Millen No. 75012 network is used.

Re-connect the phase-shift units, connecting the left-hand end of R_7 to C_7, and the left-hand end of R_{10} to C_{10}. Connect the phase-shift units to the base pins of the plug-in can assembly and solder all connections. Shunt R_8 and R_9 with the 1.5 megohm resistors previously mentioned, then place the cover on the plug-in assembly. Remember to use some insulating material inside the can as mentioned previously.

AUDIO OSCILLATOR CALIBRATION

It will be noted that the frequency ratios are such that the 12th harmonic of 326.7 CPS, the 8th harmonic of 490 CPS and the 3rd harmonic of 1306.7

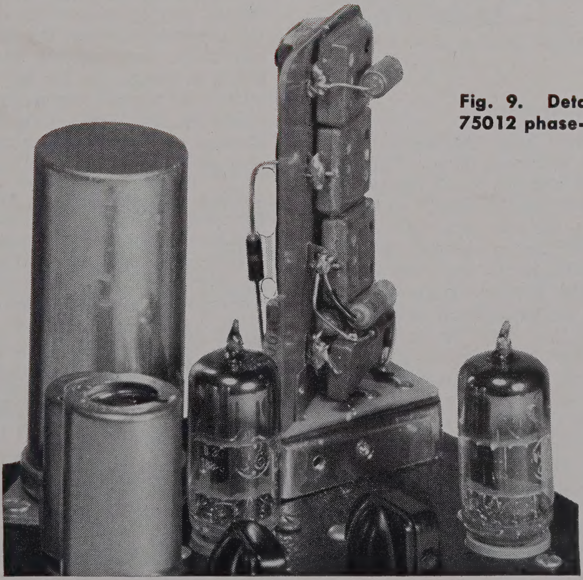


Fig. 9. Detail view of the Millen No. 75012 phase-shift network.

CPS are all the same as the 2nd harmonic of 1960 CPS, namely, 3920 CPS. Thus, if a stable source of 3920 CPS frequency (such as a thoroughly warm audio oscillator) be used as a reference, the frequency of the test oscillator can be set very closely to one-half, one-third, etc., of this reference frequency if both oscillators feed an oscilloscope and the resulting Lissajous figures observed.

Use of a calibrating frequency in this manner assures that the frequency ratios used are correct, even though the exact frequencies used are unknown. The frequency ratios (just as the resistance ratio previously mentioned) are far more important than the actual values of frequency (or resistance) used.

CONNECTION TO RECEIVER

After completion of the wiring and a thorough wire-check you are ready to connect the adapter to the receiver. The connection from the "hot" side of the I-F transformer to the diode plates of the detector in the receiver should be removed, and the audio connection from the detector output to the A-F gain control should be opened. The shield of the adapter cable connects to ground on the receiver, and the 10 mmf capacitor connects to the hot side of the I-F transformer, in place of the diode plates.

The output of the adapter may be used directly on headphones, or an audio lead may be plugged into the output jack of the adapter (J) and wired into the audio input of the receiver. It can be seen that the Signal Slicer essentially replaces the detector normally used in the receiver. The AVC action in most receivers so altered will now be completely out of service, as will the S-meter. (Even if the AVC is not disabled, it should not be used when using the Signal Slicer.) The RF gain control will be the main gain control of the receiver. It is difficult to give specific information for connection of the Signal Slicer to all receivers, but the above information covers most cases that will be encountered.

Some receivers have an accessory plug in the rear. Find out whether the amount of power available from this plug is ample to supply the requirements of the Signal Slicer if you contemplate borrowing the power from the receiver instead of using a built-in power supply. The heater power required is 6.3 volts at 1.2 amperes and the high voltage required is 250 to 300 volts at approximately 25 ma. It is recommended that the filter section consisting of R_{24}, R_{25} and C_{17} be retained regardless of the power supply used.

FINAL ADJUSTMENTS

Turn on both the receiver and the Signal Slicer and allow a few minutes warm-up time. The R-F gain control of the receiver should be all the way to zero and the AVC switch set for "manual" or "RF." Plug headphones into the output jack (J) on the adapter, set the selector switch to normal (position 3), advance the R-F gain until the receiver sounds "live" and tune in an AM station, governing the output with the R-F gain control. Keep this output reasonably low. Be certain to *tune* the receiver to maximum output (remember, there is no AVC and no S-meter) with minimum I-F bandwidth, if the receiver is so equipped, but do not use the crystal filter at this time. Trim the secondary of the last I-F transformer to compensate for any shift of its tuning caused by connection of the Signal Slicer input circuit. Set the two balance potentiometers (R_{16} and R_{19}) about midway and turn the selector switch on the adapter to one of the sideband positions (position 1 or 2). This actuates the oscillator in the Signal Slicer.

Tune the oscillator (with C_{19}) to zero beat with the received carrier, at which point good, clean audio reproduction should result. If the oscillator will not tune to zero beat within the range of C_{19}, replace C_{18} with different values of capacitance until zero beat can be obtained with C_{19} near mid-range.

Now, detune the ***receiver*** until a beat note of about 1000 CPS is heard. Try detuning first on one side, and then on the other, leaving the receiver set for the ***weaker*** heterodyne. Adjust the appropriate resistor (R_{16} or R_{19}, depending on the selector switch position) for a ***minimum*** heterodyne. Then detune the receiver to the other side of the signal, switch to the other sideband with the selector switch, and adjust the other potentiometer for a minimum heterodyne. Quite possibly neither minimum will be a complete null at this time.

Adjust C_{23} for a further reduction in heterodyne strength (readjusting the oscillator frequency with C_{19} if necessary to maintain the same beat note). Adjust the potentiometer (R_{16} or R_{19}) for still further reduction of heterodyne strength, switch to the other sideband position, retune the ***receiver*** for a beat note of 1000 CPS on the other side of zero beat, and adjust the other potentiometer for a minimum heterodyne signal strength. You will find that the sharpness of the minimum becomes more pronounced each time the above process is repeated until C_{23} is set at the optimum point, just as in balancing a bridge.

Throughout the above adjustment procedure it is assumed that the Signal Slicer is in working order other than for the correct settings of the few adjustments just covered. If no signal is heard at any time, or if excessive hum or other evidence of trouble appears, a thorough trouble-shooting routine is indicated.

OPERATING INFORMATION

After a short time of familiarization the user of the Signal Slicer will find that he listens almost exclusively to one or the other of the sideband positions, rarely ever going back to normal reception. In most cases reception of AM, NBFM, CW and Single-Sideband signals will be greatly improved over conventional reception methods. If interference appears when listening to one sideband of an AM or NBFM signal, simply switch to the other sideband to dodge the problem. Do not try to "tune out" interference—switch it out instead. Sometimes, even then, the going is rough, as we all know. That's the time to switch to normal reception to find out how rough it really is. At least, with the Signal Slicer, you can always get rid of the interference that appears on any one side of the received signal.

Since extremely close tuning (within 100 CPS) is generally necessary, the receiver should have a good bandspread arrangement, and should, therefore, have excellent stability. Some signals will be found where the Signal Slicer is of no advantage whatever because the signals themselves are characterized by excessive drift, syllabic instability, or other obvious faults. Then too, some receivers exhibit faults quite similar to those mentioned for transmitters. Do not expect the Signal Slicer to cure either a "rotten" signal or a receiver that, for instance, makes *all* CW signals sound rough, or one that has excessive drift.

In general, operate the receiver with the lowest R-F gain control setting that gives comfortable audio output. An overloaded receiver is just as bad as an overloaded transmitter (perhaps worse) as far as the listener is concerned. The crystal filter in the receiver may be used in the conventional manner.

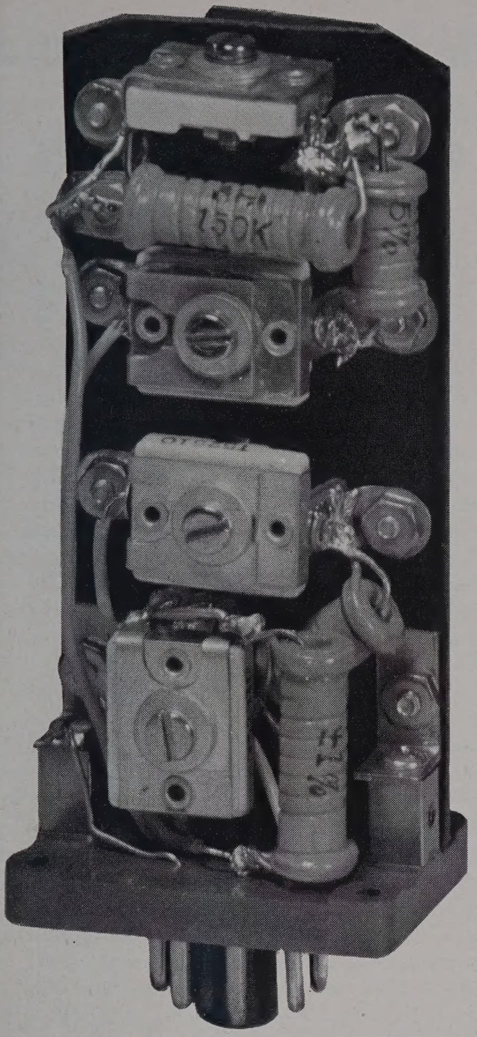


Fig. 10. Internal view of the front of the home-made phase-shift network.

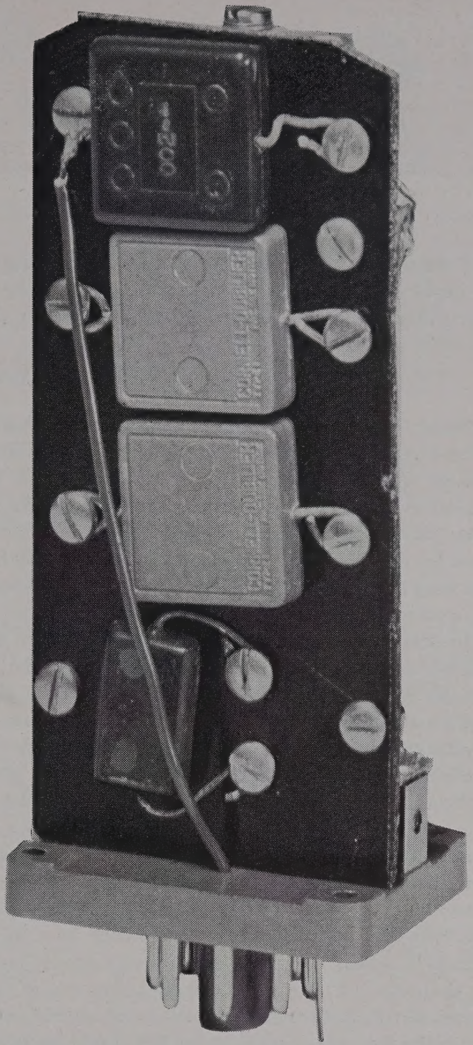
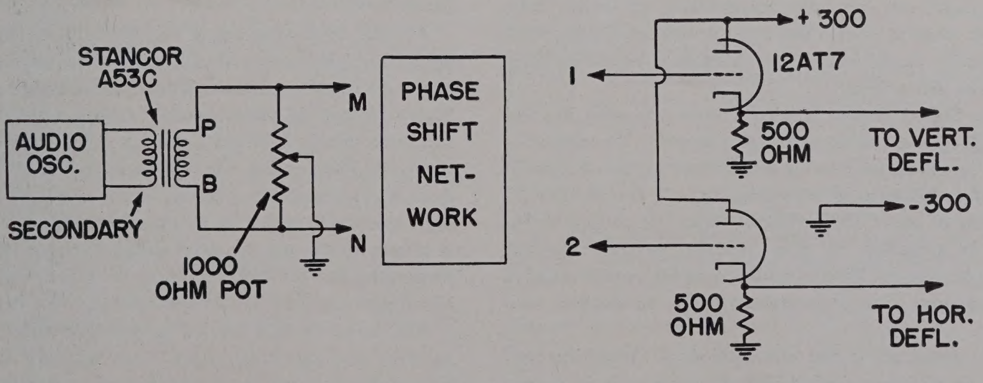


Fig. 11. Internal view of the rear of the home-made phase-shift network.


STANCOR
A53C
AUDIO
OSC.
SECONDARY
P
B
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N
1000
OHM POT
PHASE
SHIFT
NET-
WORK
+ 300
12AT7
1
500
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TO VERT.
DEFL.
- 300
2
500
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TO HOR.
DEFL.

Fig. 12. Temporary layout required to test phase-shift networks.

Designer's CORNER

Notes on the Applicatio of the Signal Slicer

I asked the designer of the Signal Slicer, W2KUJ, to make some general comments on the characteristics and use of this new SSB unit. The following remarks are his.

—*Lighthouse Larry*

Many hams who do not operate single-sideband 'phone stations feel that a single-sideband receiving system would be of no use to them. The fact is, it is probably more useful to them for receiving CW and AM 'phone signals than it would be to a SSB enthusiast for receiving SSB signals (although the SSB ham has long since learned the usefulness of such a receiving system).

In other words, if the Signal Slicer is good for SSB 'phone reception (I can assure you it is—Ed.) it should be dandy for CW, especially traffic nets, where one or more of the stations may slip away from the crystal filter and turn up missing on a few receivers.

Going a bit further in our thinking, an AM 'phone station is just like two single-sideband stations (at the same carrier frequency) that just happen to be transmitting identical signals on opposite sidebands. Therefore, one isn't missing anything if he doesn't listen to one of the signals. The Signal Slicer allows the receiving operator to select which one of the signals he doesn't want to hear. This sounds ridiculous on the face of it, until you consider that one of these "stations" is liable to be severely heterodyned, which is a polite way of saying that the QRM on that station is terrible.

If this QRM situation exists, the operator can flip a switch and hear the same transmission on the other side, where no heterodyne exists. Obviously, the operator isn't choosy about which side he listens to, as long as he can hear the same thing on either side. This is what is known as broad-nosed selectivity with extremely steep side-slope—a rather valuable asset in many situations.

The Signal Slicer, however, goes one step beyond providing just usable selectivity as such. The demodulator is made as nearly distortionless as one could pray for, because *all* incoming signals are smaller by a factor of some 200 or better than the carrier signal that is supplied by the built-in oscillator to the detector system. This is exalted carrier operation with a vengeance, but it certainly pays handsome dividends.

One dividend is the elimination of "mushing up" when receiving a fading signal; another is in reduction of the apparent volume range of a fading signal—so much so that loss of the AVC function in a receiver using the Signal Slicer is actually a distinc gain. But, don't take my word for it—try it yoursel

A word about the demodulator circuit is in orde at this point. You might be tempted (even as I was to use germanium diodes in place of the 6AL5 diod tube, and thus end up with a three-tube Signal Slice If you like to listen to noise this simplification i recommended. However, if you want a good SS receiver adapter, use the 6AL5 or some other thermionic diode tube. My physicist friends tell me tha the effective noise resistance of germanium diodes i extremely high, compared to a tube like the 6AL when you operate at low frequencies with only a fe microamperes of d-c flowing in the circuit. My friend were correct. The tube is as quiet as a tomb line with rock wool compared to the germanium diode For this particular application, a tube works ou better than germanium diodes.

Somebody (perhaps it was Aesop or Confuciu I don't recall) said that the merit of a radio receive was not in what it would receive, but in what i *wouldn't* receive. Of course, receivers have on-o switches, but what I mean is, doesn't your presen receiver receive too much?

I am certain that you will agree that many, man times, on a single frequency, you have received mo signals than you knew what to do with.

So, if these ancient philosophers were right, th Signal Slicer is a merit improver, although it's n perfect. The frequency range over which you ca expect to get at least 40 db. signal rejection is controlled by the phase-shift network, and its range i 225 to 2750 cycles per second. This, of course, mo than covers the region of most acute hearing, bu what about the audio frequency range outside thes limits?

At 4000 cycles the signal rejection due to the phas shift network is between 36 and 37 db., and at 800 cycles it is about 30 db. The audio amplifier in th Signal Slicer is deliberately designed to have response which is down 3 db. at 4000 cycles, 9 d down at 8000 cycles, etc. (This is at a rate of abou 6 db. for each octave.) Thus, at the slight sacrifice high fidelity it is fair to say that the signal rejectio is about 40 db. all the way along, because the audi response has been tailored in an identical way on th low-frequency end of the spectrum.

Add to all of this the I-F selectivity curve of you receiver and you may begin to see why we think th Signal Slicer is really about as good as anyone migh want when you consider the practical aspects o reception.—W2KUJ

SWEEPING *the* SPECTRUM

Every amateur reading the current amateur radio magazines must be struck by the fact that a large number of manufacturers are advertising that they need engineers. Just why there is a shortage of engineers at this time is a long story, and one that I'm not going to discuss here; however, I thought that you, as amateurs, might be interested in the future outlook for engineers. Many of you are about to enter college. Many of you may be engineers that are not following your profession at this time.

Is it a good idea to enter upon a course of engineering study at this time—will it be profitable for you engineers to return to engineering work? The answer is a resounding yes. To prove this you only need examine a few figures. In 1950 approximately 51,000 engineers were graduated with B.S. degrees. In 1951, 32,500 graduates are expected in the same category. For 1952, 21,500; for 1953, 17,000; and for 1954 only 12,400 graduates are predicted!

Experts in the field claim that there is need for at least 30,000 engineering graduates per year. The deficiency we will face in 1952, 1953 and 1954 is staggering. I am giving these facts to encourage all of you who have engineering qualifications to think about taking an engineering course, and to convince those of you that are engineers that you should use your engineering ability where it will do you, and our country, the most good.

⁂ ⁂ ⁂

The figures quoted above for predicted graduates in engineering came from an editorial written by Mr. E. S. Lee, editor of ***General Electric Review***, which appeared in the April, 1951 issue of that magazine. Or did you know that General Electric publishes a regular monthly magazine? I have tried, in these columns, to give you a better idea of our company, but perhaps I have never mentioned the ***Review***.

This magazine has been serving electrical industry for a good many years. In fact, it will shortly celebrate its fiftieth birthday. It is edited for engineering men, and contains general-interest articles as well as articles dealing with specific design and application problems of current interest.

If you have been searching about for another good magazine to add to your present technical library, you might consider subscribing to the *General Electric Review*. You would be in good company, as many of the top engineers in the country are subscribers. The rate, incidentally, is $4.00 per year or $6.50 for two years.

⁂ ⁂ ⁂

Fellows, believe it or not, the first run of the G-E *Ham News* bound volume was a complete success. So much so, in fact, that we have none left. We are thinking of making more available, if there is sufficient demand, but the boss wants me to tell him how many more to prepare. It would help a lot if I could get an expression of opinion from my readers. So, again, I ask your help. If you would like to get a bound volume of the G-E *Ham News*, drop me a postcard, and I'll see that one of the new batch is reserved for you.

Here are the details on the book, just as a reminder. It is a cloth-bound book containing 214 pages. Every issue of the G-E *Ham News*, from Vol. 1 No. 1 through Vol. 5 No. 6, is included. In other words, all issues from the very first, up to the November-December, 1950 issue. The price is $2.00 postpaid. To reserve a copy send your postcard to: Lighthouse Larry, Bldg. 267, General Electric Company, Schenectady 5, New York.

⁂ ⁂ ⁂

I hope that all of you are familiar with the Civil Defense organization in your community. Even if some of us are unable to devote any time or equipment to our local organization, we should be acquainted with the overall plan so that we can act as operators in time of actual emergency. Most organizations are faced with an operator shortage. This becomes apparent when you consider that each control point, in time of actual trouble, must be manned 24 hours a day, for perhaps four or five days. One transmitter in one control point may therefore require the services of at least three operators, each on 8 hour shifts. Multiply by three the number of transmitters, including mobiles, that you have in your organization, and you will see just how many operators really are needed. One way or another, deal yourself in on civil defense.

—*Lighthouse Larry*

GERMANIUM DIODES

CONDENSED SPECIFICATIONS

G-E Type	Forward Resistance (Ohms)	Back Resistance (Ohms)	Inverse Voltage (Volts)
1N48	250	60,000	85
1N51	400	30,000	50
1N52	250	333,000	85
1N63	250	1 meg.	125
1N64	Tested for efficiency in detector circuit.		
1N65	400	250,000	85
1N69	200	59,000	75
1N70	333	122,000	125
1N72	Tested for efficiency at 500 mc.		
1N73	Balanced quad.		
1N74	Balanced quad.		
1N75	400	1 meg.	125

Note: For detailed, guaranteed specifications see bulletins X57-04-59 and X57-015.

INTERCHANGEABILITY CHART

Competitive Type	Replace with G-E Type	Competitive Type	Replace with G-E Type
1N34	1N48	1N57	1N52
1N38	1N52	1N58	1N63
1N40	1N73	1N60	1N64
1N41	1N73	CK705	1N48
1N42	1N73	CK706	1N64
1N43	1N69	CK707	1N52
1N47	1N70	CK708	1N63
1N54	1N65	CK710	1N72

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GEO. H. FLOYD, W2RYT—EDITOR

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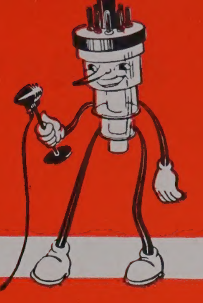


6-METER RECEIVER

Economical Six-tube Superhet for DX, Mobile or CD Use

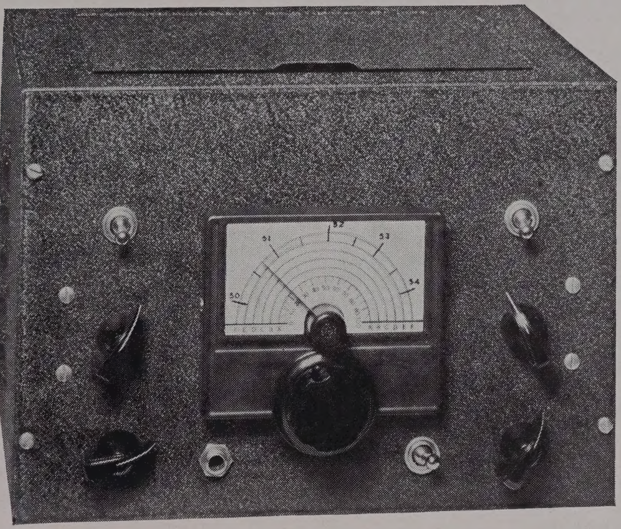


Fig. 1. Front panel view of six-meter receiver. Controls in bottom row, left to right, are audio gain, headphone jack, AVC switch and r-f gain. The BFO control and switch are at upper left, and ANL control and switch at upper right.

A receiver designed and built for a single amateur and may seem like a luxury to many amateurs, but is is not the case when the high-frequency bands are nsidered. Band-switching can be accomplished on equencies between 50 and 150 megacycles. In fact, any commercial band-switching receivers now in-ude the six-meter band. However, inclusion of more an one band on any receiver means that the design a compromise, and the higher the frequency con-dered, the greater the compromise.

This does not mean that it is simple to design a one-and receiver, but it does mean that the designer can evote his efforts to producing a receiver which has aximum performance over a narrow range of fre-uencies. Usually this means a superior receiver and, rangely enough, a simpler receiver.

This six-meter receiver about to be described is simple, has low current drain, and yet has a noise figure of between 5 and 7 db. Most important of all, it is not difficult to build. The average amateur should have no trouble putting it together and making it work properly.

DESIGN CONSIDERATIONS

Basically, the idea was to get a six-meter receiver that was sensitive enough to do serious DX work, and yet be simple to build and low in cost. Because this receiver might be used for civil-defense work or mobile work, power-supply drain became a consideration.

Six miniature tubes are used, two of them twin-triodes and one a twin-diode. This gives the receiver the equivalent of nine tubes. All of the popular superhet functions are included: AVC, BFO and noise limiter. In order to keep the design simple, no trick

ntents

6-meter Receiver....................pages 1-5
Technical Tidbits (Receiver Noise Figures)....................page 6
Sweeping the Spectrum....................page 7

6-METER RECEIVER

circuits are employed. Sensitivity is achieved by the proper choice of the input circuit and r-f amplifier tube.

The idea of double-conversion, that is, the use of two different I-F frequencies, was discarded because it would add to the complexity of the receiver. The receiver as designed could use more selectivity—most receivers can—but until the six-meter band becomes more heavily populated, the selectivity achieved in this receiver is adequate.

In order to keep the six-meter receiver independent of the a-c line, the power supply has been eliminated. For home use a separate a-c power supply can be employed, and for mobile or civilian-defense use a vibrator power supply is adequate. The voltage required is not critical (225 to 300 volts) and the current drain is low (50 to 65 mils).

MOBILE AND CD ASPECT

It might seem strange to say that a receiver which is housed in a 10 by 7 by 8 inch cabinet is suitable for mobile work, but such is the case. Recent trends in mobile and emergency work have been to keep the transmitting and receiving equipment as an integral unit, yet one which is not mounted in any particular car.

This system has several advantages. For example, assume that the receiver, transmitter and vibrator power supply are mounted on a piece of wood which will fit comfortably on the front seat beside the driver. Two clip leads can be used for the battery connection, or a special lead can be used which will plug into the cigarette lighter socket. All that is needed now is an antenna (assuming a relay is used to switch the antenna from transmitter to receiver).

The antenna may be mounted on the car, or the antenna may be mounted on an insulating boar which fits or clamps over the glass on one of the c windows. In the latter case, the entire station is con pletely independent of the automobile.

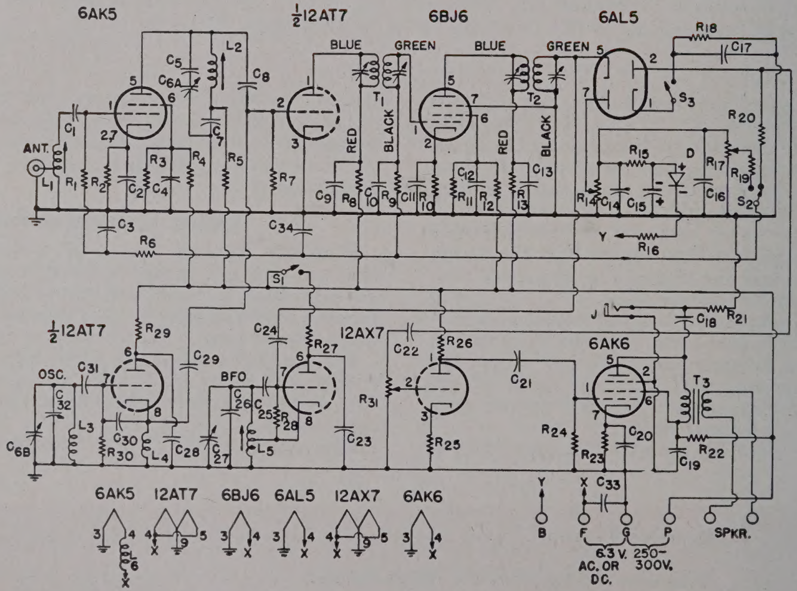
Only an independent station installation of this so can be considered to be a true emergency station. An car which is available serves as the home for a static of this sort. Any six-volt car battery serves as a prim source of power. Thus the station can be used in a attic, in a medical center, or even in the top of a tre A mobile rig *mounted* in a car can only go where a ca can go, while an independent station can go anywher that human hands can carry it.

CIRCUIT DETAILS

Refer to the circuit diagram, Fig. 2. The 6AK miniature tube serves as a pentode r-f amplifier. Th input circuit is broad-band; that is, when L_1 is co rectly tuned, the r-f stage will operate properly ov the range 50-54 megacycles. In order to maintain low noise figure and broad-band characteristics, it vital that the proper antenna be used. For the co stants shown a 50 ohm antenna is correct. A 75 oh antenna can also be used if some change in the banc pass characteristics can be tolerated.

The 6AK5 tube feeds a 12AT7, one half of whic serves as the local oscillator, and the other half actin as the mixer. Both the oscillator and mixer hav tuned circuits, with C_{6A} tuning the mixer grid an C_{6B} tuning the oscillator grid. The oscillator section a Colpitts oscillator. This type of circuit is used s that a coil tap is not required. The r-f choke require in the cathode circuit is relatively simple to provic at this frequency. The oscillator is designed to work c the high side of the received signal, for reasons whic will be discussed subsequently.

Electrical Circuit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6AL5
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L1
L2
L3
L4
L5
C1
C2
C3
C4
C5
C6A
C6B
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
C32
C33
C34
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
R30
R31
T1
T2
T3
S1
S2
S3
D
Y
J
½12AT7
OSC.
BFO
12AX7
6AK6
6AK5 12AT7 6BJ6 6AL5 12AX7 6AK6
B
F
G
P
X
SPKR.
6.3 V. AC. OR DC.
250–300V.

Fig. 2. Circuit diagram of six-meter receiver

A single 6BJ6 acts as the I-F amplifier, operating : 5.0 megacycles. The reason for the choice of this equency is worth discussing at this point. As preiously mentioned, double conversion was ruled out ı the design of this receiver. The receiver must tune ver a range of four megacycles. If the intermediate equency is lower than two megacycles, images will e found in the 50-54 megacycle band. What about sing an intermediate frequency of 2500 kilocycles? his could be done, but it presents problems. For cample, the oscillator would be on 52.5 megacycles hen the receiver was tuned to 50 megacycles. The f section is broad-band, so that any leakage of signal om the oscillator into the r-f stage would tend to lock the receiver and make it insensitive to 50 megarcle signals.

Another problem is that of coupling the oscillator › the mixer grid. It was felt that the average ham ould have some difficulty with tracking if 2.5 megarcles were to be used as the intermediate-freuency.

It would be possible to use ten megacycles as an ıtermediate frequency, but the receiver would have ıuch less selectivity than one using five megacycles. o sum up, 5.0 megacycles was selected because the nage problem, overload problem and coupling prob-m were minimized, and because it is possible to get easonable selectivity and gain with only one I-F age.

The frequency of exactly 5000 kilocycles has much › recommend it. For one thing, the I-F stage can be djusted to this frequency by the use of WWV. econd, in most cases WWV does not have a suffiıently strong signal to cause interference. At least, ou know what is on 5.000 megacycles! In the event ıat this receiver is used in an area where WWV is too trong, the actual intermediate frequency may be changed plus or minus fifty kilocycles without affecting the tracking.

It is possible to add a second I-F stage and achieve additional selectivity. This was not done because the advantages were outweighed by the disadvantages. Another I-F tube would be required, and the plate current for this tube, added to the current already required, would bring the total current requirements for the receiver well above the fifty milliampere figure desired. The additional gain would not be sufficient to permit the use of only one audio stage, and if the second I-F stage were used more care would be needed to keep the I-F system adequately shielded.

A bias source is used in this receiver for the noise-limiter system and for complete control of r-f gain. This bias is obtained by rectifying the 6.3 volt filament supply with a small germanium diode. This rectifier works from either an a-c or a d-c source, so that mobile operation is possible. An explanation of this will be given later.

The use of such a bias system permits the r-f gain of the receiver to be reduced to zero (this is not true of a self-biased r-f gain system). The I-F stage uses a remote-cutoff tube, which means that the gain of the r-f system decreases faster than the gain of the I-F system, when the r-f gain control, R_{17}, is adjusted to progressively lower gain settings. The effect keeps the front-end from overloading. It would be desirable, from the cross-modulation standpoint, to have a remote-cutoff tube in the r-f amplifier stage, but such a tube would give a poorer noise figure, so the sharp-cutoff tube is used.

One section of a 6AL5 serves as the diode second detector, and the other half acts as the diode for the noise limiter circuit. The limiter is a parallel clipper circuit whose clipping level is adjusted by means of the potentiometer R_{14}. The bias voltage available is

CIRCUIT CONSTANTS

(All resistors and capacitors ±20% tolerance unless specified otherwise)

$_1$, C_{17}, C_{26}	100 mmf mica or general purpose ceramic (Sprague 19C11)
$_2$, C_3, C_4, C_{12}	1000 mmf mica, paper or high-K ceramic (Sprague 19C1)
$_5$	10 mmf zero-temperature coefficient ceramic (Sprague 19C3)
$_{6A}$, C_{6B}	Split-stator variable, 12 mmf per section (Millen 23912C)
$_7$, C_8, C_{28}	1000 mmf mica or general purpose ceramic (Sprague 29C21)
$_9$, C_{10}, C_{11}, C_{13}, C_{16}, C_{23}, C_{33}, C_{34}	5000 mmf mica, paper or high-K ceramic (Sprague 29C1)
$_{14}$, C_{15}	50 mf 25 volt electrolytic (Sprague TA-50)
$_{18}$, C_{21}, C_{22}	0.05 mf 400 volt paper (Sprague 68P10)
$_{19}$	8 mf 450 volt electrolytic (Sprague UT-8)
$_{24}$, C_{29}	2 mmf ceramic (see text)
$_{25}$	50 mmf mica or general purpose ceramic (Sprague 19C28)
$_{27}$	10 mmf variable, single-spaced (Cardwell ZR-10-AS)
$_{30}$	5 mmf mica or general purpose ceramic
$_{31}$	10 mmf mica or general purpose ceramic (Sprague 19C19)
$_{32}$	15–120 mmf mica compression trimmer (El Menco 302-M)
)	Crystal diode (G-E 1N48)
	Open-circuit phone jack
$_1$	12 turns No. 26 enamel wire close-wound on slug-tuned coil form ⅜ in. in diameter. Tap 2 turns from ground end (Millen No. 69042 coil form)
$_2$	5 turns No. 26 enamel wire close-wound on slug-tuned coil form, ⅜ in. in diameter (Millen No. 69042 coil form)
$_3$	4 turns No. 14 wire ½ in. in diameter space-wound
L_4, L_6	6-meter RF choke made by winding 44 turns No. 30 enamel wire, close-wound, on $\frac{5}{16}$ in. diameter, one megohm, 2-watt resistor
L_5	36 turns No. 36 enamel wire close-wound on slug-tuned form ⅜ in. in diameter. Tap 9 turns from ground end (Millen No. 69042 coil form)
R_1, R_9, R_{27}, R_{28}, R_{30}	100,000 ohm, ½ watt
R_2	220 ohm, ½ watt
R_3	*39,000 ohm, 1 watt (±10%)*
R_4, R_{12}	*39,000 ohm, 2 watt (±10%)*
R_5	*19,500 ohm, 4 watt (two 39,000 ohm, 2 watt ±10%, resistors in parallel)*
R_6	10,000 ohm, ½ watt
R_7, R_{21}	1.0 megohm, ½ watt
R_8, R_{29}	4700 ohm, 2 watt
R_{10}	68 ohm, ½ watt
R_{11}	68,000 ohm, 2 watt
R_{13}	10,000 ohm, 2 watt
R_{14}	20,000 ohm potentiometer
R_{15}	2200 ohm, ½ watt
R_{16}	22 ohm, ½ watt
R_{17}, R_{31}	250,000 ohm potentiometer
R_{18}	220,000 ohm, ½ watt.
R_{19}	2.2 megohm, ½ watt
R_{20}	4.7 megohm, ½ watt
R_{22}	*6000 ohm, 4 watt (two 12,000 ohm, 2 watt, ±10%, resistors in parallel)*
R_{23}	470 ohm, 1 watt
R_{24}	0.47 megohm, ½ watt
R_{25}	3300 ohm, ½ watt
R_{26}	330,000 ohm, ½ watt
S_1, S_3	SPST toggle switch
S_2	SPDT toggle switch
T_1, T_2	465 kc. I-F transformers altered as per text
T_3	Output transformer, 10,000 ohms to voice coil (UTC R-38A)

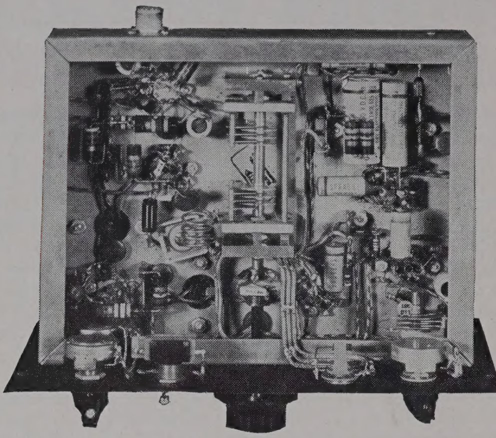


Fig. 3. Underchassis view of six-meter receiver

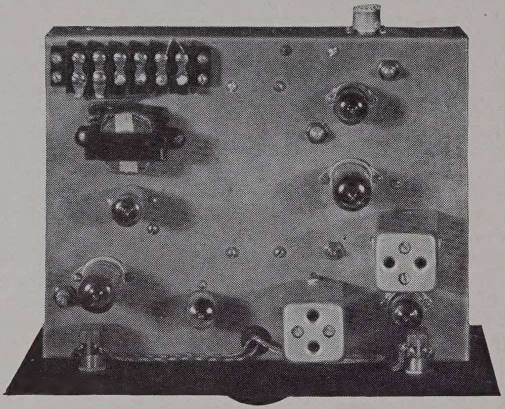


Fig. 4. Top view of six-meter receiver

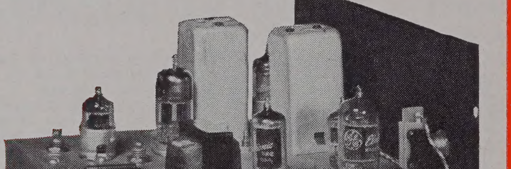


Fig. 5. Side view of six-meter receiver

more than sufficient to provide a complete range of clipping level. Use of the noise limiter will be discussed later.

When the arm of S_2 is connected to R_{19}, the r-f gain control is in use, and when the arm of S_2 is connected to R_{20} the AVC system is in action. The noise limiter is turned on by connecting together pins 1 and 2 of the 6AL5 through S_3.

One-half of a 12AX7 twin-triode is used in the bea frequency oscillator circuit. The circuit shown is Hartley oscillator. A Colpitts oscillator could ha been used, but it seemed easier, at this frequency, use a tapped-coil Hartley than to provide the cathoc choke required for the Colpitts circuit.

The other half of the 12AX7 tube serves in the fir audio amplifier stage. This tube was selected becau it is a high-gain tube, yet requires only a modera amount of current. The output stage uses a 6AK which provides a watt or so of power for the lou speaker. A word of precaution about the output stag If earphones are used, make certain that the lou speaker is connected to the speaker terminals, or, you do not wish to use the speaker, connect a ten-oh two-watt resistor across the speaker terminals. T secondary of the output transformer must always properly terminated if damage to the transformer to be avoided.

CONSTRUCTIONAL DETAILS

It is recommended that the mechanical layo shown in the photographs and sketches be followe exactly. A receiver operating on the six-meter band capable of developing a lot of trouble unless care taken with parts placement and lead length. T layout shown was used only after a great deal thought had been put into getting an efficient ar well-planned placement of parts.

The cabinet selected for the six-meter receiver seven inches high, ten inches wide and eight inch deep. The chassis used is a standard seven by nine b two inch chassis. In order to maintain a symmetric panel layout and yet have correct parts placement, tl chassis is attached to the panel so that the top of tl chassis is three inches from the top of the panel. Th leaves two inches below the bottom of the chassis, c the panel, for the mounting of parts, and places tl main tuning dial high enough so that tuning is co venient.

The exact placement of parts is indicated in tl layout sketches and the photographs. Small holes a not indicated on the sketches, but the location of tl major components is shown. The position of the ma tuning dial is not indicated, because this will deper upon the type of variable condenser used (C_6) and tl type of dial used. The dial shown is a Millen N 10039.

Inasmuch as five-megacycle I-F transformers of tl desired type are virtually unobtainable, it is necessa to purchase 465 kilocycle I-F transformers and co vert them. Practically any low-frequency I-F tran former is suitable which does not have an iron-co form. Burned-out transformers would be ideal, as lor as the mica trimmer condensers in them are in goo condition. The transformers used in this receiver a Meissner "Plastic" I-F Transformers. The tran formers are 1¼ inches square and 2½ inches high ar are rated for the frequency range from 400 to 5 kilocycles. Three types are available: input, outp and interstage, any of which can be used because yo are going to remove the coils anyway. The numbers these three transformers are: 16–6658, 16–6659 ar 16–6660.

Regardless of the type of transformer you procur make certain that you do *not* get an iron-core un Further, try to get transformers that have a co form ⅜ or ½ inch in diameter. The coil-form in tl Meissner transformers just described has a ⅜ inc diameter. It is necessary to enlarge this to ½ inc diameter, but this is easily done by winding the for with paper until it is the right diameter, then puttin on a final layer of transparent tape. Now, follow tl sketch of the windings shown in Fig. 8, and wind eac coil with 40 turns of No. 30 silk or enamel wire. Tl pacing between coils is 5/8 inch, as shown, and the ire is close-wound. The 40 turns of close-wound No. 0 wire should just take up the 3/8 inch winding space hown. For proper connections, follow the color coding shown in the circuit diagram and that shown in ig. 8. After the coils are wound a small amount of ement may be applied to them to hold the wire in lace.

The capacitor which couples the oscillator energy nto the mixer, C_{29}, and the capacitor used for BFO njection, C_{24}, are specified as 2 mmf ceramic condensers. It is possible to use a pair of twisted wires in lace of the ceramic condensers. This might even be referred in the case of C_{24}, because the BFO injection an be varied by means of the twisted-wire condenser ntil injection is optimum. Some experimentation nay be needed on C_{29} also, although this is not as ritical as C_{24}.

The bottom view of the receiver, Fig. 3, shows that hielded wire has been used for the leads that go to the arphone jack and to the audio gain control, R_{31}. This advisable in order to prevent feedback between the udio and the I-F portions of the receiver. Shielded ire is also used for the connections to the noise limiter witch, S_3, as may be seen in the top view of the eceiver, Fig. 4.

If the cabinet used has a solid back it will be necesary to drill two clearance holes in this back to pass the oaxial connector and the wire leads going to the erminal board.

TELEVISION STATION IMAGES

If a television station in your locality operates on hannel three, you will receive an image of the sound arrier at 55.75 megacycles, but since this is outside he 6-meter band, it should not be troublesome. The ideo carrier, however, which is centered at 61.25 negacycles may cause a troublesome image at 51.25 negacycles. If this is the case, you may wish to install rejection filter in the receiver antenna circuit. The .R.R.L. Handbook gives design details on such a lter. It is not advisable to move the oscillator frequency below that of the incoming signal, because the racking of the receiver will be seriously affected. urther, the image problem is probably more serious vith the oscillator running in the range 45-49 megaycles.

COMPONENT PARTS

Practically none of the parts used in this receiver re critical. Five resistors are specified with a tolerance of ten percent, but all other parts carry a twentypercent tolerance. The manufacturer's name and part number are shown in the Circuit Constants list wherever practical. Use of the flat ceramic condensers pecified is recommended because they permit you to naintain short lead lengths in the wiring. Further, hey take up very little space.

When purchasing these new flat ceramic condensers bear in mind that they come in three general types: 1) those suitable only for bypassing applications (and some coupling applications) where the capacitance stated is a guaranteed minimum value only; 2) those suitable for general purpose use as alternates for foilmica condensers; and 3) those suitable for use in resonant or frequency-determining circuits. The information given under Circuit Constants should enable you to obtain the right condenser for each particular job. The Sprague type numbers given are those of the condensers actually used in the receiver pictured.

The Millen coil form specified for coils L_1, L_2 and L_5 uses a powdered-iron slug. Brass-slug coil forms can be used, but the coils will probably require a different number of turns if this is done.

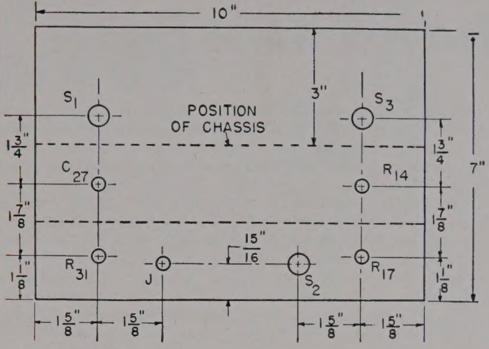


Fig. 6. Front-panel layout

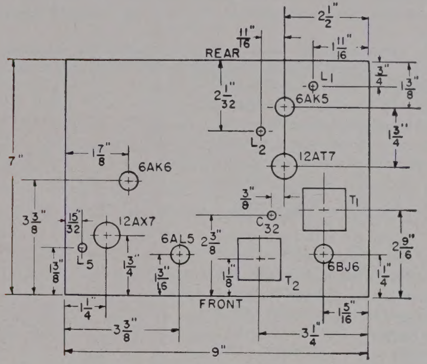


Fig. 7. Chassis layout

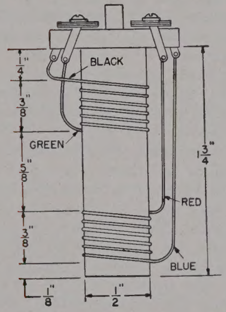


Fig. 8. Detail of I-F coil winding

FINAL ADJUSTMENTS

Terminal "B" on the terminal board supplies either an a-c or a d-c voltage to the bias rectifier. If the receiver is to be used with a-c on the filaments, connect a strap from terminal "B" to terminal "F", then connect the 6.3 volts a-c to terminals "F" and "G". If a 6-volt battery is to be used for the filament source, terminal "B" can stay connected to terminal "F" if the *negative* of the battery is connected to the junction of terminals "B" and "F", and the positive terminal of the battery is connected to terminal "G".

It is essential that a negative d-c voltage be applied to terminal "B" in order that the bias rectifier will pass the direct current and supply bias for the r-f gain control and the noise limiter. If the receiver is used in a car where the negative of the battery is connected to

(*Continued on page 8*)

Receiver Noise Figures

The purpose of this article is to explain in simple language the terms "noise figure" and "signal-to-noise ratio." Admittedly this is not an easy job, but it will be attempted here because so few amateurs have a clear concept of just what noise actually is.

There are four general types of noise, and we are concerned primarily with only one type in this discussion. Static is one type of noise. It is produced primarily by lightning discharges. A second type of noise originates far from our planet Earth, and is called cosmic noise. Third, we have that well-known phenomenon, man-made noise, such as electric razors, which give off a noise similar to a hiss, and we have power leaks and ignition noise which sounds like a series of machine-gun shots. The three types of noise just mentioned are interesting, and they will help us to understand receiver noise problems, but they have absolutely nothing to do with so-called receiver or circuit noise. However, it is this fourth type of noise that we are interested in, because it is the only one we can do anything about.

This type of noise had better be called by another name, which is "thermal" noise. This name describes rather accurately the cause of this type of noise, because it is due to thermal agitation of electrons. That is, in every bit of matter, the electrons are moving back and forth, and this motion causes noise. The only way to stop this noise is to cool the electrons down to absolute zero, where they are just too cold to move. Thermal noise, in other words, depends upon the temperature (among other things), and the hotter the electrons, the greater the noise.

Technical TIDBITS

What does this mean practically? For one thing, it means that your antenna generates noise, the resistors in the input circuit of your receiver generate noise, and the input tube generates noise, all due to the random motion of the electrons in the antenna wire, the resistor, etc. In fact, practically everything in the receiver generates noise, but generally only the noise in the first stage of the receiver means anything, since noise in subsequent stages is much less than the amplified noise from the first stage.

Thermal noise is random and appears at all frequencies. However, if a receiver is "sharp" there will be less noise in the output, because the receiver is looking at a smaller part of the radio spectrum than a broad receiver, and therefore it is amplifying less of the noise. Now that we have some of the fundamental ideas in mind, let's see what signal-to-noise ratio is.

Let us assume we have a receiver with an antenna connected to it. Present on this antenna will be all four types of noise (static, cosmic, man-made and thermal). Also present on the antenna is a certain signal that we want to receive. Let us assume further that the noise (all four types) on the antenna is a certain power, say one microwatt. Let us also assume that the signal has a strength of ten microwatts. The signal-to-noise ratio on the antenna is therefore 10–1. This is a comfortable margin, and you might think that the signal would be easy to receive. It would be, with a good receiver. However, remember that the receiver has its own internal noise. When this signal plus noise gets to the grid of the first tube, there may be enough additional noise added by the input circuit that the total noise power is now five microwatts. The signal is still ten microwatts, but now the signal-to-noise ratio is ten microwatts to five microwatts, or 2–1. You experts may realize that the example above represents a practically defunct receiver in an even worse location, but the figures do serve to illustrate the problem.

We have had a terrible loss in signal-to-noise ratio, and we barely got the signal into the receiver! Also, from this point on, the receiver can not improve things. The first tube is going to amplify the signal and the noise by the same amount, and subsequent stages will do the same, so by having a po front end on the receiver we have a poor signal-to-noise rat to work with, and there is nothing we can do about it, exce re-design the receiver. It is interesting to note that even if had noise-free tubes (which we don't), there would still noise generated by the input circuit (the antenna, lead-i input impedance, etc.) We can minimize the noise generat in these elements only by careful design.

Let's go back to signal-to-noise ratio again, and assume th the noise on the antenna consists entirely of thermal noise d to the radiation resistance of the antenna. (This means th the antenna is in that perfect receiving location that everyo is looking for but never finding.) We have a certain signal-t thermal-noise ratio on the antenna, and the ideal receiv would be one which did not change this signal-to-noise rat If the receiver adds no noise whatsoever, then the signal-t noise ratio remains unchanged, and we have what is known a perfect receiver. The better a receiver you have, the less t signal-to-noise ratio will be changed, and the worse the receiv the more the signal-to-noise ratio will be changed. The amou that the receiver changes the signal-to-noise ratio can be e pressed as a figure—in fac this is called the "noise figur of a receiver. In other wor the noise figure of a receiver the measure of how much t signal-to-thermal-noise ratio decreased due to the receiv itself.

By going into this matter little more thoroughly, we c see just what this noise figu means expressed in figure Assume we have some receive with a bandwidth of 25 kil cycles. Let us assume al that we have an antenna with radiation resistance of 1 ohms, and that this antenna at room temperature. (I'm not going to explain this room-ter perature statement—it is included just to keep this who thing technically correct.)

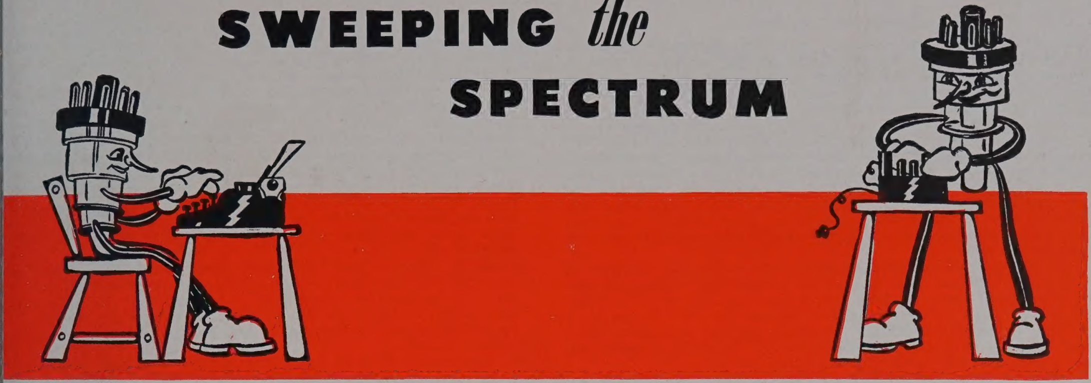
The thermal noise power due to this 100 ohm radiation r sistance is 0.0004 micro-microwatts (this corresponds to a 0 microvolt noise voltage). Now we will listen to a signal with power of 0.002 micro-microwatts (about a 0.5 microvolt signal The signal-to-noise ratio on the antenna in this case is therefo 0.002 to 0.0004 or 5 to 1. Now, let us connect two hypothetic receivers, having the bandwidth previously mentioned, to th antenna and see what happens. The first receiver is one havi a noise figure of 13 db. This might be considered a fair receive by the way. What happens to the signal-to-noise ratio with th receiver? Well, 13 db is a power ratio of approximately 20 to so that the noise will be increased 20 times, up to 0.008 micr microwatts. The signal-to-noise ratio with this receiver will 0.002 divided by 0.008 or 1 to 4. The noise is four times strong as the signal. Well, let's try the other receiver.

Assume we have a receiver with a noise figure of 6 db (t six-meter receiver described in this issue of *Ham News*, f example). Six db is a power ratio of four to one, so now o signal-to-noise ratio will be 0.002 divided by 0.0016, or 1.25 1. The signal is louder than the noise, so we stand a good chan of hearing the signal with this receiver.

What are typical noise figures for various types of receiver This is an interesting question, and you may be surprised the answer. Very good receivers have noise figures of about to 10 db. Receivers have been built with noise figures as lo as a fraction of a db, but these were laboratory receivers— least, none are available commercially. An average fair supe heterodyne that you might call a communication receiver liable to have a noise figure as poor as 30 db. Going furthe a broadcast-band, table-model, ac-dc set might have a noi figure as high as 50 db! You pay your money and you take yo choice. Of course, you don't need a low-noise receiver for t broadcast band—that's why there are so many fifty kilowa broadcast stations.

—*Lighthouse Larr*

SWEEPING *the* SPECTRUM



I wonder how many of you have had the experience f firing up a new high-frequency transmitter or ceiver, only to find that there was no one on the and? It always happens to me. The two, six and ten eter bands seem to be great gobs of silence when I ant to make a test. It isn't that I insist on the band eing open—I'd even settle for a local! If you have ad that trouble, maybe the six-meter receiver escribed in this issue of the *Ham News* will break the harm for you, just as it did for me.

The first time I tuned across the band I heard a 9 calling CQ. I was so startled that I forgot to turn n the transmitter, and for the next half-hour I stened-in on a very nice six-meter opening. When I uit, after thirty minutes, the band was still active, nd I had had a chance to turn all the knobs and witches on the receiver. I considered it a most successful evening.

The receiver worked just like the lab instruments aid it would. Sensitivity seemed excellent, even when ompared to another pet receiver of mine, and the oise limiter had a fine workout when a neighbor rove his car in the driveway and kept the motor lling while he opened the garage door. It must be uman nature to insist on an actual listening test with receiver, when we know the receiver has been horoughly aligned on the bench. Units that appear in he *Ham News* are always given on-the-air tests, by he way. That's a policy.

* * *

The amateurs in this area have had their share of rouble with television, but in typical ham fashion nost of us have eliminated TVI and now we are using elevision for our own purposes. It's strictly a man-ites-dog story. By carefully alerting the XYL to vatch for certain disturbances in the TV picture, we an tell when the six-meter band is open. Because the YL is usually an avid TV viewer, this works out erfectly.

In case you would like to try this system, here is ow it works. When propagation conditions are just ight for a six-meter opening, it is not unusual to have reak television reception, which will allow you to eceive TV stations from quite a distance. The distant V station will therefore interfere with your local TV tation. Normally this interference consists of horizontal bars in the picture, or what the television ervicemen call venetian-blind effect. These bars may nove up or down very slowly, or they may lock in. When you see this effect, or when your wife calls your ttention to it, make a break for the rig, because the hances are good that six-meters is red hot. It goes without saying that your six-meter rig must be de-TVI'ed—after all, you have to keep on the good side of the XYL if you want her to watch for those horizontal bars.

* * *

One of my readers in Detroit, Glenn Ross, writes in to remind me that the new Novice Class license should provide a number of operators for the civil-defense setup. This is a good thought, Glenn, and one that I'm happy to pass along. Of course, the Novice Class license limits operation to c-w on 3700 to 3750 kc. and 26,960 to 27,230 kc., and phone between 145 and 157 megacycles, but the latter band may work into some civilian-defense setups.

More important, it seems to me, is the fact that every Novice is a potential General Class license holder. In fact, the Novice must become a General Class amateur at the end of one year or lose his license. It is up to us, the General and Advanced Class amateurs, to see that this does not happen. Let's give all the encouragement and help that we can to the Novices. Perhaps your local ham club can start the ball rolling with special courses or meetings for the Novice Class amateurs as they become licensed in your community.

* * *

In the May-June *Ham News* I mentioned some facts about the Schenectady General Electric plant, and several readers have written in to say they would like to hear more about it. With a cue like that, I can't refuse.

For one thing, Schenectady is the headquarters of an inter-works trucking service which does all the long-distance hauling between the eastern plants of the Company, carrying G-E mail and packages. This fleet of heavy-duty trucks plays a big part in keeping business going—in effect it makes it just as if these plants and offices were all in one spot, because it's an overnight service. In 1950 this fleet of trucks covered 1,145,797 miles!

Schenectady is also the location of one of General Electric's eight telegraph-switching centers. A very elaborate arrangement transfers messages between circuits by the simple operation of a push button. Everything that can be done to make the system automatic has been installed, because the message load is very high. In an average day, the G-E telegraph network handles 16,000 telegrams, all of them concerning G-E business.

Even such a seemingly simple operation as the mailing of dividend checks to G-E stockholders can be a major operation in a company the size of General Electric. Among other things, this involves the signing of approximately 250,000 checks. This is neatly handled by a special machine, otherwise someone would be bound to get a glass arm.

—*Lighthouse Larry*

(*Continued from page 5*)

ground, then it will be necessary to use a bias battery in order to obtain bias. In other words, terminal "G" on the receiver is the ground terminal. The receiver ground must be grounded to the automobile ground, which means that in the case stated above, the negative 6 volt supply is at ground potential. The positive 6 volt terminal of the battery can be connected to terminal "F" and still supply filament power, but terminal "B" must be disconnected in this case, otherwise bias voltage would not be developed. However, a small 7.5 volt bias battery can be used, with its negative terminal connected to "B" and its positive terminal to "G." Inasmuch as most cars have the positive side of the battery grounded, it is unlikely that you will encounter the few types of cars with a negative ground system.

To test the receiver, connect either an a-c or a d-c source to terminals "F" and "G" and check to make sure that all filaments are lit. Then connect the negative of the high voltage supply to "G" and the positive voltage to "P." Connect a speaker across the "SPKR" terminals, or use a ten-ohm two-watt resistor in place of the speaker. Connect an antenna to the input, and the receiver is ready to operate.

If you have a grid-dip meter its use is highly recommended. Set L_1 to 52 megacycles with the grid-dip meter. Set C_6 to mid-scale and adjust C_{32} until the oscillator is operating at 57 megacycles, as shown by the grid-dip meter. Now check the frequency of L_2 and adjust the slug in L_2 until it is resonant at 52 megacycles. (All the tubes should be in place when the above adjustments are being made.) If a grid-dip meter is not available, it will be necessary to provide a 52 megacycle signal with a signal generator or with your transmitter, and peak the circuits for the best output when the receiver is operating.

Turn on the receiver, and connect an output meter across the speaker terminals—either a speaker or a load resistor should still be in place. Use the grid-dip meter as a signal source at 52 megacycles, or use some other source of signal, until the output meter shows a deflection. For this test the AVC switch should be in the "off" position. Use the r-f gain control to set the level or the output meter to some convenient point. Also, the noise limiter switch, S_3, and the BFO switch, S_1, should be in the "off" position. Now, increase the intensity of the r-f signal, either by moving the grid-dip oscillator closer to the receiver, or by advancing the gain on the signal generator, and make certain that the output meter shows an increase in reading when the r-f signal is increased. This is merely to check that the receiver is not overloading. If the output meter does not show an increase in gain, you are using too much r-f signal. In this case, decrease the r-f signal until a slight increase in the r-f signal shows up as a slight increase on the output meter.

Once the above conditions are satisfied, you may align the
intermediate transformers in a rough manner by adjusting th
four trimmers in the I-F transformers for maximum deflectio
of the output meter. The two I-F transformers will now b
operating approximately on the same frequency, so the nex
step is to set this frequency to 5.0 megacycles. Use a signal gen
erator capable of operation on 5.0 megacycles. You may chec
its frequency against WWV if you so desire. Connect the out
put of this signal generator to pin 2 of the 12AT7 through a 10
mmf condenser, and advance the control on the signal generato
until you get a suitable deflection on the output meter. No
adjust the four trimmers in the two I-F transformers again, i
order to get a maximum reading on the output meter. If th
output meter tends to go off-scale, reduce the input by th
control on the signal generator. The I-F strip should now b
aligned.

Next, remove the I-F signal generator and put a signa
into the receiver with an r-f signal generator, and if you ar
using an adjustable condenser of twisted wire for C_{29}, adjus
this until you get a maximum signal in the output meter. Thi
capacitance can be too low or too high, so search for the op
timum point.

The next step is to turn on the BFO and tune the receive
to the frequency of the signal generator, and listen to the beat
note obtained. Adjust C_{24}, assuming you are using a twisted
wire capacitor, until the beat note is the desired strength
Tune C_{27}, the BFO pitch control, to make certain that yo
have adequate range. If you do not hear a beat, adjust L
until a beat appears. Tune L_5 slowly, as the frequency chang
is quite rapid when tuning this coil. Obviously, a speaker o
earphones must be used for this test. The receiver should no
be ready to put on the air.

OPERATING INFORMATION

Use a good antenna, and one with the proper impedance
When properly constructed, this receiver should have a nois
figure of about 6 db, which means that it is a very sensitiv
receiver. As stated before, the I-F bandwidth is not as sharp a
some might like it, but it is adequate unless you run into sever
QRM conditions. The actual bandwidth will be between 2
and 40 kilocycles, to the half-power point.

The noise limiter is the threshold type, which means it mus
be adjusted according to the strength of the received signal. I
you experience noise, turn on switch S_3 and advance R_{14} unti
the noise is just equal to the received signal. If the contro
is advanced further, you will clip the signal as well as the noise
After a little experience you will be able to use the noise limite
control easily, and you will realize the advantage you have i
being able to decrease the noise to the point where it is n
louder than the received signal.

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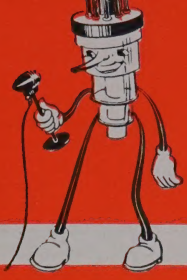

TRICKS & TOPICS

This entire issue is devoted to one of the popular Ham News *departments—Tricks and Topics. Here you have the pet ideas of twenty-six different amateurs from the United States and Canada. I hope that you will be able to use some of them to save time or money in your amateur radio work.*

—*Lighthouse Larry*

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300-ohm Twin-lead Connector

It is quite simple to make a chassis socket for 300 ohm transmission line from a regular female connector. The sketch, Fig. 1, gives the details. First, drill and tap the female connector for one or two machine screws so that it may be mounted on the underside of the chassis. Next, file a slot in the chassis so that the female connector just protrudes slightly. If desired, you may drill two oversize holes for the two pins rather than filing a slot, although the slot makes a neater job.

Geo. Tracy, W2EFU

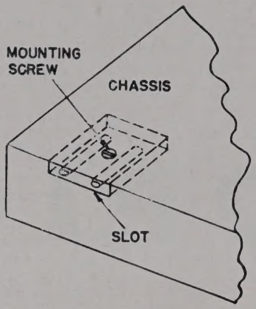

Figure 1

Repainting Panels

I have been interested in reading how various amateurs refinish their crackle-paint panels, and I have yet to see anyone mention my favorite method, which I think is extremely simple. For years I've solved the problem by simply dipping a cloth into one of the usual jars of crackle paint you buy at a jobbers, and rubbing well into the seedy old panel (after cleaning, of course!)

No heat is applied, and when the paint is spread thin it dries quickly with that new sparkle. Of course there are no brush marks and no brushes to buy or clean. Being the same sort of paint as the original, it blends well, and if you miss a spot it isn't noticed. No spray gun, no mess—well, almost none, just your fingers!

Chas. E. Spitz, LJ2Z (W7JHS/W5QML)

Inexpensive Shielded Plug-in Coil

Recently while working on a mobile rig I decided to use plug-in coils. I needed quite a few coils, and decided that buying the shielded plug-in units was too expensive, so, I came up with this idea.

Use the aluminum film containers that are sold with 35 mm. film. The top can be punched with a $1\frac{1}{16}$-inch punch, and a standard octal base from a metal tube will fit in snugly. This octal base can be removed from any defunct metal tube. After the octal base is inserted, the aluminum can be pressed with a screwdriver into the four slots on the base, to prevent the base from rotating in the metal.

Some of the 35 mm. film cans have no threads, and in this case you will find that the can itself is a snug fit on the metal shell of a GT type base. When this type of can is used, it is unnecessary to drill a hole in the top cap, and the cap is discarded.

Edson B. Snow, W2BZN

Neutralizing Condenser for Tetrode

Here's my solution to a pair of adjustable rods f neutralizing the beam-power tetrodes in my fin amplifier. See Fig. 2.

The ordinary open-circuit jacks are mounted on piece of insulating material, such as mycalex poly, and installed so the rods are about three-fourt of an inch from the tubes. The rod is a piece one-fourth inch brass or aluminum or any meta The tip connector of the jack gives fine spring tensio and holds the rod in any pre-adjusted position. Th body and tip connection on the jack is wired to th grid of the opposite tube.

Cliff Dow, W6ZB

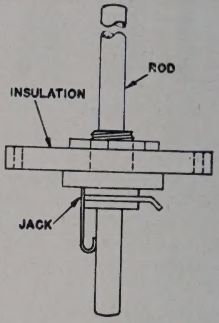

Figure 2

Waterproofing Mobile Antenna Coil

To the mobile-minded hams that want a wate proof housing for the loading inductance in a vertic antenna—such as the Mastermount or similar types— here is my solution. Even when the antenna is fu nished with a metal housing, many hams discar this so that they can get at the coil readily for tests.

Look around at your favorite five and ten cen store and you will locate plastic glasses. These com in various sizes, and you can pick the size that sui your particular loading coil. Be sure you get the typ that has a close-fitting cover. You can use one glas or, if your loading coil is large, you will have to us two glasses.

If one glass is all that you need, mount in th manner. Cut a hole in the bottom of the glass larg enough to accommodate the portion of the loadin coil that screws into the bottom portion of the an tenna. Remove the loading coil and cut a small ho in the cover, and slip the cover on the upper portio of the antenna. Now, place the glass in positio fasten the loading coil in place, and slip the plast cover down on the glass. The fit is usually goo enough between cover and glass that no wate proofing is needed at this point. After all, the plast glasses are made so that liquids may be carried i them even when the glass is upside down. Howeve use clear cement where the antenna goes throug the cover, and also at the point where the loading co fastens on the bottom of the glass.

If you use two glasses, you can cut them to lengt so that they just cover the loading coil, and ar fastened at each end of the loading coil by means the loading coil hardware. In this case, the tw glasses face each other with their mouths touchin and holes are drilled through the bottom of eac glass, one hole being at the bottom of the loadin il and the other hole being at the top of the loading il. Use both covers, and where they meet apply ar cement liberally. Also, cement the top and bot- n joints.

If you desire to tap the coil, place the taps on first, en run the wires through the sides of the plastic isses before cementing.

You can get various color glasses to match your r, and the whole antenna loading coil assembly will quite attractive.

George W. Pilgram, W0DWF

lounting Filter Condensers — No. 1

Now and then an amateur will acquire some of the etal-can filter condensers that are perfect in every spect except that the mounting clamps are missing. I lved this problem and at the same time ended th a rather neat-looking assembly (see Fig. 3).

Holes are drilled in the chassis through which the ndenser feed-through insulators are placed. A ece of thin insulating material, such as bakelite or er is cut to size and drilled and then fastened to e condenser by the nuts on the feed-through ter- nals. Finally, the insulating piece is fastened to e chassis and the job is complete.

Sid Sheard, VE3BCL

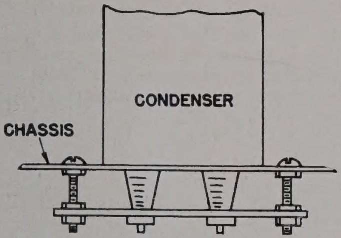

Figure 3

lounting Filter Condensers — No. 2

After I purchased some rectangular-can filter ndensers I was troubled because no mounting straps ere available. However, I overcame this problem in e following manner.

Take two small bolts and remove the heads with a cksaw. Place these in position on the sides of the ndenser and solder them in place. It is wise to tin e bolts before soldering. Arrange the bolts so that ey extend over the bottom of the condenser far ough to go through the chassis. The bolts may be aced on either the top or bottom of the condenser, epending on whether you mount the condenser right- de-up or up-side-down.

It is surprising how easily bolts may be soldered these condensers. I have used this idea for many ears now and have never had a bolt come loose.

George C. Gallaher, W4PJC

QSL Card on Your Car

I have one of those new-fangled cars with the license plate space built into the bumper, and nary a place to hang one of those nice cast aluminum call-letter plates. This concerned me on a trip to Florida, even more so when we went along and I saw mobile ham jobs on the highway.

In Miami I determined to do something about the situation. I made a trip to the local 5 and 10 and bought a plastic book cover—such as used by people to protect their new books—and a roll of transparent tape. Total cost, thirty-five cents. Using a pair of scissors I cut a rectangular piece of plastic slightly larger than my QSL card. With the tape I attached the whole job to the car (see Fig. 4).

This is not a permanent job, of course, but when I came home after two weeks of tropical rain, really hot sun, some snow, and a good car wash, my call sign was as bright and colorful as ever.

A sign of this sort really gets results. The first day I had it on a filling station man directed me to the home of W4IL, where my wife and I had a nice visit—including some grapefruit and avocado right off the tree.

Phil Boardman, W3KEW

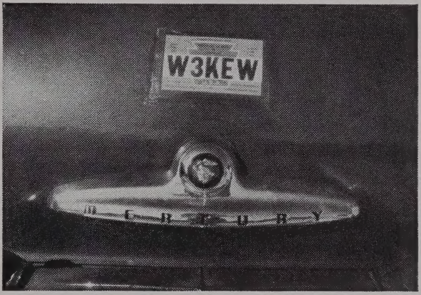

Figure 4

Multiple-Connection Terminal Strip

Here is an idea for an unusual type of terminal "strip" I concocted recently for use in an already crowded receiver chassis. See Fig. 5.

This stack requires a single mounting hole, which, in many cases, can also be a tube socket mounting hole. The screw is a 6–32 machine screw which is cut to the desired length, depending on the thickness of the fiber washers and the number of terminal points desired. This screw is covered with a piece of tight-fitting spaghetti, then the washers and soldering lugs are alternately piled on the screw.

Many variations of the basic idea are possible as regards length, number of separate tie points, radial arrangement and spacing.

Elmer J. Bauer, W9ECX

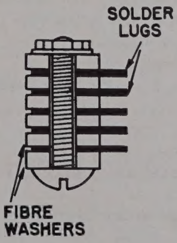

Figure 5

Color Code Memory Rhyme

Here is a trick which I have found to save me much time and freedom from exasperation. There are many occasions when a ham needs one particular resistor or condenser and he has a boxful on hand, but, no color code chart handy. He may vaguely recall the colors, and with this information he tries to pick the proper resistance. Maybe it's the right value and maybe it isn't. To clear away those doubts, here is a simple rhyme to help you remember the condenser-resistor color code:

0	1	2	3	4	5	6	7	8	9
Better	**Be**	**Right**	**Or**	**Your**	**Great**	**Big**	**Venture**	**Goes**	**Wrong**
L	R	E	R	E	R	L	I	R	H
A	O	D	A	L	E	U	O	A	I
C	W		N	L	E	E	L	Y	T
K	N		G	O	N		E		E
			E	W			T		

Joseph A. Butkiewicz, W8EHC

Tricks with a Soldering Gun

If you happen to use one of the so-called soldering guns, you may be interested in several handy tricks. The first concerns demagnetizing. If you have any tools that are magnetized, they can be easily demagnetized in this way. Turn on the gun and insert the tool into the space between the heavy supports to the soldering element. Leave the tool in a few seconds, then with the gun still "on" draw the tool out of the gap and away from the gun at right angles until it is held at arm's length. Turn off the gun. The a.c. field which the tool has been exposed to will destroy the residual magnetism in the tool if the tool was not too strongly magnetized.

This same method can be used to demagnetize a watch. My watch is subjected to magnetic fields which affect its operation and at times cause it to stop completely. I tried the soldering gun for this purpose and it does the job nicely.

A tool may be magnetized with a soldering gun also. Hold it in the gap between the secondary terminals, as before, and sharply trigger the gun. After each triggering check the tool for magnetism. Several attempts may be necessary, and, results are not as satisfactory as using a permanent magnet to magnetize the tool.

The field of the transformer of the soldering gun may also be used as an aid in trouble-shooting. When held near a transformer of the type which is not shielded against external magnetic fields, the gun may be triggered and will induce a signal into the circuit through coupling effects. For example, the gun may be held near an audio interstage transformer or audio output transformer to induce a signal which may be heard in the loudspeaker, providing the circuit is functioning normally.

H. Paul Bohlander, W3VVS

Harmoniker Improvement

A very useful improvement can be made to a Harmoniker (G-E *Ham News* Vol. 4 No. 6) if a standing wave indicator is added. The sketch (see Fig. 6) shows how three neon bulbs are placed in th circuit and wired across each junction of the network When all three neon bulbs glow with equal brillianc the mismatch is nil. Any difference in glow betwee the bulbs indicates that a mismatch is present.

Mechanically, the bulbs must be placed inside th Harmoniker box so that the box remains completel shielded. I accomplished this by using small screene holes through which the neon bulbs could be observed The series resistors indicated in the circuit diagran are of a value which will allow the neon bulbs t light normally and not burn out, and this value de pends upon the type of Harmoniker used and th power of the transmitter used.

F. L. Taylor, W8AW

(Editor's Note: There are six types of neon lamp that will operate in this sort of circuit. Two of them NE-2 and NE-51—are 1/25-watt lamps. Four of ther —NE-17, NE-45, NE-48 and NE-57—are quarter watt lamps. The following list gives the correc value of resistance to use with each of these lamps depending on the voltage in the Harmoniker:

Lamps NE-2 and NE-51—750,000 ohms for 250–30 volts; 1.0 megohm for 300–375 volts; 1.2 megohn for 375–450 volts; 1.6 megohm for 450–600 volts.

Lamps NE-45 and NE-57—82,000 ohms for 250–30 volts; 120,000 ohms for 300–375 volts; 150,000 ohm for 375–450 volts; 200,000 ohms for 450–600 volts.

Lamps—NE-17 and NE-48—110,000 ohms fo 250–300 volts; 150,000 ohms for 300–375 volts 180,000 ohms for 375–450 volts; 240,000 ohms fo 450–600 volts.

Each resistor should have a wattage rating ap proximately three times the wattage rating of th lamp with which it is used.

The voltage in the Harmoniker can be compute from the formula given on page 6 of Vol. 4 No. *Ham News*. Because these neon bulbs will not ligh when too low a voltage is placed on them, this whol idea is restricted to Harmonikers used with trans mitters of several hundred watts output.—*Lighthous Larry*.)

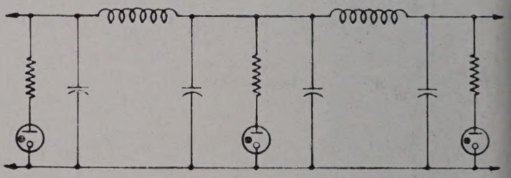

Figure 6

Drilling Window Glass

Ever try to bring an antenna lead-in through window? I was puzzled as to how to get the holes i the glass, when I hit upon the idea of using a B gun. I took careful aim, and "drilled" two holes, a inch apart, in the window.

The holes placed by this method have a diamete of about one-eighth inch. I needed holes one-fourt inch in diamater, but I solved this problem b reaming the holes with a one-half inch taper reamer

I am pretty sure that you won't find a quicker wa than this for putting holes in glass. If you are doubt ful, try it first on a piece of scrap glass.

Donald Valentine

Removing Miniductor Turns

When using the Barker & Williamson Miniductor oils removing turns sometimes is a problem, especially when you want to prune the coil to the correct nductance and only need to remove one or two turns. have found it is extremely simple to do in this anner. Merely place a hot soldering iron on the ire near the plastic support piece. As the wire ecomes warm, it will pull out of the plastic piece asily. Repeat this process for each quarter-turn to emove as much wire as desired.

Jos. J. Cobry, VE6DR

TV Herringbone Pattern

If you or one of your neighbors are having trouble ith television interference that you are unable to nd, check around and see if there are any lamp bulbs ith carbon filaments in use, either in the immediate icinity or in some of the nearby houses. When these amps are faulty they radiate broad bands of r.f. nergy. The pattern on the TV screen caused by hese lamps will usually be horizontal bands, somemes in the herringbone style and other times just road dark bands.

The solution is to replace the carbon filament amp with a modern lamp, and make sure that the ld lamp bulb gets destroyed.

C. D. Birkhahn, W2PKN

Editor's Note: A photograph of this effect, from he files of the General Electric Lamp Division, is hown in Fig. 7. Television channels 2, 3, 4 and 5 re the channels most affected by this sort of radia-on, with channel 4 seeming to receive the largest art of it.—*Lighthouse Larry.*)

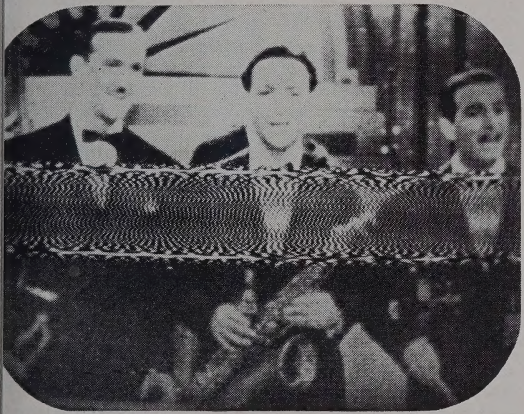

Figure 7

Ceramic Coil Form Terminals

Many types of slug-tuned ceramic coil forms have een available in the past few years on the surplus narket. Some of these have no terminals on them, hat is, no place to connect the wire on each end after coil has been wound. It is rather difficult to do a eat winding job if you are unable to anchor the ends f the wire; so faced with this problem, I came up ith the following solution.

Procure some $\frac{1}{16}$ inch thick bakelite, poly or fiber, nd cut round or square pieces which can be drilled ith a hole slightly smaller than the diameter of the ceramic form. Also drill two small holes to serve as a tie point for the wire. Next, cut a slot in the material with a hacksaw. You will find that the pieces will now slide on the ceramic form and make a tight fit. The advantage of this method is that the terminals may be adjusted to any position on the form, so as to be close to the end of the coil winding, regardless of the length of the winding. After the coil is complete, the terminal pieces may be cemented to the ceramic form.

The sketch gives the details on the terminal pieces. See Fig. 8.

Moe Joffee, W2BNY

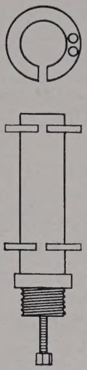

Figure 8

Drilling Panel Holes

The amateur constructor who has to bore a number of holes for toggle switches, potentiometers, miniature tube sockets and other holes of the same approximate diameter will find this trick of value in saving time and skinned knuckles.

Purchase several sizes of round "rat-tail" files. These should cover the range of size from one-quarter inch up to the largest size hole you wish to drill. The half-inch size, for example, is ideal for toggle-switch holes. When these files are placed in a brace and rotated backwards the file bores a smooth round hole in a short length of time. By testing the diameter with calipers and then marking the desired point on the file with chalk or string, the hole can be made a size desired without removing the file and measuring the hole from time to time. A quarter-inch hole can be drilled first with a hand-drill or an electric drill to serve as a pilot hole for the file.

S. L. Peppin, VE1BN

Mounting Trimmer Condensers

Small compression-mica trimmer condensers are sometimes difficult to mount so that they can easily be adjusted from the top of the chassis. To solve this problem neatly, I solder the condenser terminals to the terminals of an octal socket, in such a way that the adjusting screw on the condenser is aligned with the hole in the socket. The socket is then mounted on the chassis in the usual way. Or, if you desire, the socket can be mounted under the chassis and a hole of the proper size to take the shaft of the screwdriver can be drilled in the chassis directly over the socket. This is an extremely rigid support and is far superior to any other method of mounting with such ease of accessibility.

Richard E. Carrier

R.F. Ammeter Switch

It is possible to employ only one r.f. ammeter to measure the antenna current in both sides of the transmission line if care is taken to maintain a balanced and symmetrical line. My solution to this problem is as follows:

Use a triple-pole double-throw ceramic wafer switch. See Fig. 9. A switch of this sort, when not switched under load, is capable of handling 5 amperes with no difficulty. If a greater current capacity is required, use two wafers in parallel.

Note that the wire from A-1 to C-3 and the wire from B-3 to C-1 run along with the metering wire from B-1 to C-2. Regardless of where the meter is placed, these two wires should parallel the metering wire. By running the wires in this manner the transmission line impedance can be approximated and thus prevent an impedance "bump" in the line.

C. Ray Wagner, W2FEN

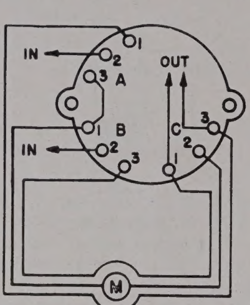

Figure 9

Tube Carton Source

A few years after getting his license the average amateur has a collection of radio tubes which are a chore to store properly. Receiving tubes generally end up in a cardboard box, usually without the protection of the original tube carton. I had this problem myself until I found this solution.

Procure several of the corrugated cardboard containers that hold fluorescent lamps. These are the same length as the fluorescent lamp and just large enough to be a snug fit. Cut these cartons into lengths which will accommodate your receiver tubes. Leave enough length so that a flap can be cut on each end and folded over. Seal this flap with a label on which you have written the tube type number.

These fluorescent lamp cartons come in different sizes, depending on the size of the lamp, and these different sizes will hold practically any size receiving tube, from the miniatures up through the large glass types.

James F. Glennon, W2RRR

Relay For A.C. or D.C. Use

The readers of the G-E *Ham News* are well aware of the current problems involved in providing suitable emergency communications, whether fixed or mobile, for the many types of jobs that amateurs are doing. Many groups of amateurs agree that the solution to the equipment problem involves the design and construction of good low-power equipment which can be used with a variety of power supplies, whether they be a.c. or 6-volt powered.

The weak spot in many units appears to be in providing a good relay switching system for push-to-talk operation, which is a practical necessity fo almost any emergency communication gear. Most o us think in terms of low-voltage relays—6 volts or so. Using relays of this type the situation becomes awkward. If you use a 6-volt a.c. relay it will tend to overheat and burn up on d.c. and if you use a 6-volt d.c. relay you must provide a rectifier system when running from an a.c. source.

A simple solution to this problem is to use a d.c. relay which has a high-voltage operating coil. For example, one well-known relay manufacturer makes relays which operate on either 120 or 240 volts d.c. at a power consumption of two watts. Thus the 120-volt relay requires 17 mils current and the 240-volt relay requires 8 mils operating current. If the latter relay is used it may be powered directly from the high voltage supply. Most equipment installations can spare 8 mils for this purpose. In the case of the 120-volt relay, a dropping resistor can be used to supply the 120 volts directly from the high-voltage supply. At any rate, whenever the transmitter is powered, a source of high-voltage must be turned on whether the primary source be 120 volts a.c. or 6 volts d.c., and this high-voltage source can very easily supply operating current to a high-voltage d.c. relay.

S. G. Reque, W2FZW

Making Meter Shunts

Many amateurs, from time to time, want to make higher-range milliammeters from lower-range units. These low-range meters may have basic movements anywhere from 0–1 to 0–5 mils and by appropriate shunt resistors these can be adapted to read almost any current.

The calculations of resistance value for a shunt to make a given meter read 0–300 mils, for example, are not too difficult. However, the answer usually comes out to be a fraction of an ohm. Everything is just dandy, except that the average ham has no way o accurately measuring such small resistance.

After much scratching of his head, he gets a bright idea. Look in a wire table and there, in plain print, it says that No. 30 wire has a resistance of 0.1052 ohms per foot. With a ruler and some arithmetic the problem should be solved.

I've been through all this many times, and in my hands, the problem is solved—but only approximately. Upon comparison with a good meter, my shunts are usually off by two to a dozen scale divisions. This may be due to methods of fastening the shunt to lugs or binding posts on the meter, or the size or composition of the wire may be non-uniform or maybe it's just part of the general cussedness o things.

Now, I think I've got the problem licked by this device: I cut my shunt a little too long so that the error is always on the side of the meter reading too high (which means the wire is longer than is necessary). Then, with a good meter in series with mine and also in series with a dry-cell and a resistor that will give about mid-scale reading, I run a little solder from the lug out on the shunt wire itself, thus lowering the shunt resistance. This process is repeated until the two meters give equal readings. Before you try this stunt, make sure that the shunt is mounted permanently on the meter, as you won't want to change anything after you get the shunt exactly the right resistance.

Milton I. Schwalbe, W4VP

SWEEPING *the* SPECTRUM

It has been a difficult job picking the winning tries for this issue of the *Ham News*. Each cf the icks and Topics entries that I get is the pet stunt some clever amateur, and most of the entries serve publication. So, my job has been to select e "excellent" from among the "very good."

Unfortunately, I believe that there are no really w ideas, so some of you may find tricks that are d to you. If this is the case, congratulate yourself, cause you were clever enough to have thought of e idea first. On the other hand, maybe you shouldn't el proud, as you might have sent the idea to me and ceived that ten dollars worth of tubes yourself.

Speaking of money, I still need lots of good ideas r future Tricks and Topics columns. How did you lve that last problem that almost stumped you? hether the idea is about tubes, antennas, or cirits—as long as it concerns amateur radio—I would e to hear about it. For each "trick" published you ll receive a certificate entitling you to $10 worth of E tubes.

Mark your letter "Entry for Tricks and Topics" d send it to Lighthouse Larry, Bldg. 267, General ectric Co., Schenectady 5, New York. (In Canada nd it to Canadian General Electric Co., Ltd., pronto, Ontario.)

* * *

I have been utterly amazed by your response to e G.E. *Ham News* bound volume. It seems that eryone wants one! As you may recall, when I iginally proposed the idea in this column of the *am News*, I was not at all sure that the idea would over with the *Ham News* readers, with the result at we were cautious about the matter, and prepared ly a small number of books. These were sold in the st few weeks.

Since then, we have had trouble keeping up with e demand. Many of you who sent money in have d to wait almost two months to get your book. I n extremely sorry for this delay, but this wait was casioned by trouble at the bindery.

When this column appears in print the bound volne situation should be well in hand, and I will be appy to receive more orders. The bound volume der discussion contains all copies of the G.E. *Ham ews* from Vol. 1 No. 1 through Vol. 5 No. 6 and lls for $2.00 postpaid. Orders may be addressed to ghthouse Larry, Bldg. 267, General Electric Comny, Schenectady 5, New York. Please make remitnce payable to General Electric Co.

* * *

On September 13 the General Electric Company sponsored a Civil Defense Conference at Electronics Park in Syracuse. Present were more than 300 people, representing 3 countries, 30 states and 70 cities. Many of those present were either city mayors or local civil defense heads. The purpose of the conference was to give municipal government heads the opportunity to get the latest information on civil defense from speakers prominent in government, industrial and amateur circles.

Col. W. M. Talbot, Director, Attack Warning and Communications, Federal Civil Defense Administration, gave a very stirring talk on Federal Planning and State Systems. Brig. General Jacob E. Smart, Vice Commander, Eastern Air Defense Command, told of the part that the civilian must take in aiding the military in civil defense.

A very interesting comment came from Major General Kirke B. Lawton, Deputy Chief Signal Officer, Dept. of the Army. He said the bane of civil defense is the "nice" person who refuses to do anything for civil defense. I'll bet every radio club has one or more of these people in its ranks. I wish that you might have been there. I believe you would have been convinced of the seriousness of the threat now posed to this country. As General Lawton said, complacency on the part of the American citizen is one of Russia's secret weapons.

The new General Electric movie on civil defense entitled *And a Voice Shall Be Heard*, prepared by The March of Time for G.E., had its preview at the conference. This movie tells the story of civil defense in Onondaga County, New York. The opening shot shows an amateur working on his antenna. While the film is not primarily concerned with amateur communication work, nevertheless the part the amateur is capable of taking in this work is accurately presented.

Copies of this film are available on loan to organizations wishing to borrow it. The running time is approximately 20 minutes, and the film is 16 mm. sound. Address any requests for this film to your nearest General Electric office.

* * *

A report issued recently by the Bureau of the Census states that approximately 95 per cent of all homes have radio sets, and about 12 per cent of all homes have television. Looks like radio is here to stay and television is increasing in popularity. How's your TVI?

— *Lighthouse Larry*

That Old Nut and Bolt Trick

As you *Ham News* readers may recall, I started something a year or so ago when I mentioned a favorite trick of mine for starting machine nuts on bolts that were in out-of-the-way places, and ever since then I have had other amateurs sending in their pet ideas on the same subject. The latest group of letters included these four ideas.

— *Lighthouse Larry*

After reading in *Ham News* about how the boys put a nut on the end of an inaccessible screw, I would like to tell you how I do it. I use a pencil without any lead, and screw the nut on the pointed end, so that it just holds. Then I place the nut over the end of the screw and push the nut off onto the screw with a scriber. The pencil is held against the screw until the scriber is used to start the nut on the screw threads.

Charles Affleck, W7MAN

I thought surely that my pet idea for holding and placing nuts would be published by now, but as long as it hasn't been, here it is. Instead of using solder, as W6AKQ does, I use a screwdriver. Lay the nut on the bench and force the bit of the screwdriver straight down through the first thread. (An ordinary knob screwdriver fits No. 6 nuts to a "T.") As you force the bit in you will hear a slight snap as the bit goes through the first thread. Use the screwdriver as a wrench, and as you screw the nut on, the screw will come through the nut and force the screwdriver out the rear. It's worked for me for years.

Jack Watt, W8HYQ/W8GGT

Why use any of the ideas in the March-April 195 *Ham News* for mounting screws? Why not mak yourself a tool for that very purpose? Here is how made one. Get a small alligator-type spring cli and bend the nose into a V and an inverted V s that the nose will fit on a machine nut. Next get length of flexible spring and solder it to the rear o the clip. Finally, take a screwdriver which has outlived its usefulness and solder the spring on the blad end of the screwdriver. The screwdriver will nov serve as the handle for your tool. Clip the nut int the jaws of the alligator clip, and push the nut t any corner of the chassis you desire.

Q. E. McDuffie, W9JSY

My favorite method of starting a nut on a screv which I can't reach with my fingers involves the us of a pencil. Remember the penny pencil with th tapered eraser? That's the type I use. The nut ca be twisted on the eraser end, and then placed righ on the screw. In most cases the eraser will not com completely through the nut, so that the screw ca be started while the nut is still on the eraser.

Dave Blosser, W8MDL

PARASITICS

This is more of a clarification than a correction and it pertains to the circuit diagram on page 2 o the September-October 1951 *Ham News*. The connection from the top of S_3 does connect to pin 2 o the 6AL5, despite the fact that no dot is shown a the connection point.

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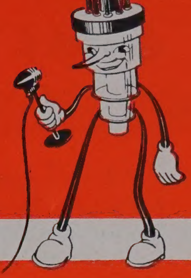

6-METER XMTR

Economical Fifteen-watt Phone-CW Transmitter for Mobile or CD Use

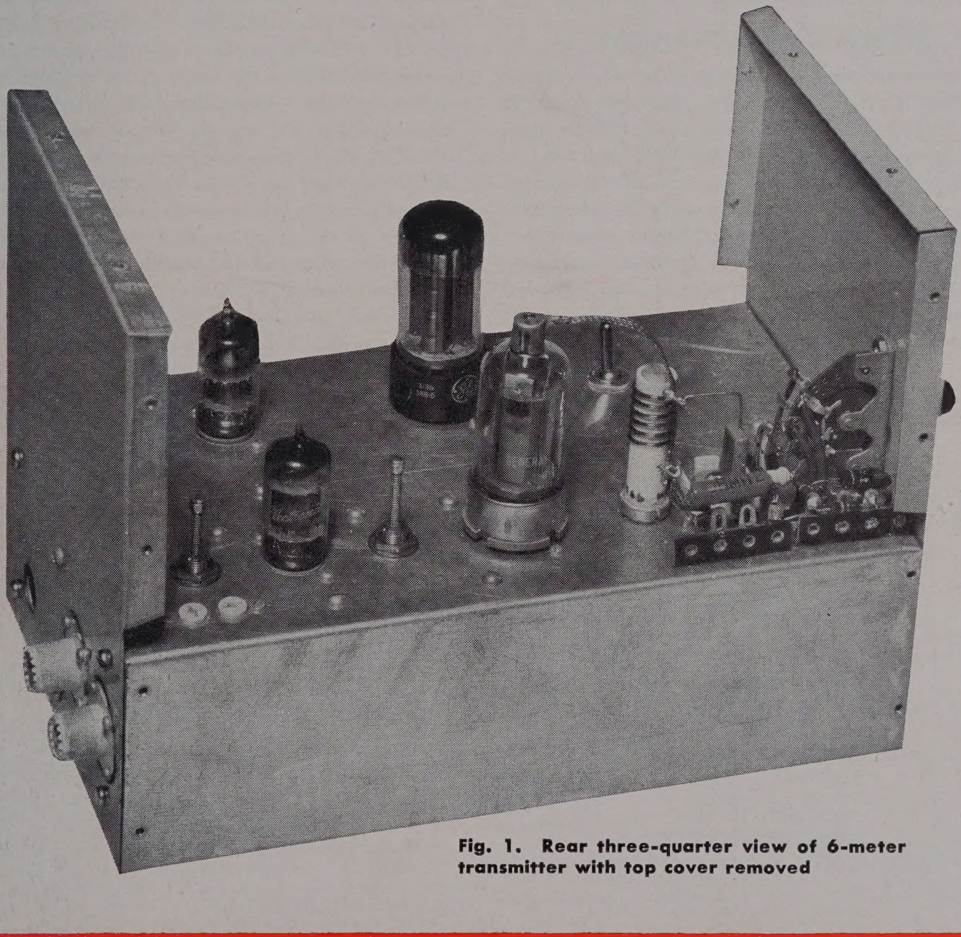

Fig. 1. Rear three-quarter view of 6-meter transmitter with top cover removed

ontents

6-Meter Transmitter........pages 1-10
Sweeping the Spectrum........page 11
Technical Information (GL-2E26)........page 12

6-METER XMTR

This transmitter has been designed specifically for civilian use, for either fixed-point or mobile operation. Schenectady County amateurs use this exact design for their fixed-point installations. Simplicity and reliability were the two major design points considered. The result is an economical four-tube transmitter, with two tubes in the r.f. section and two tubes in the modulator section.

Features of this six-meter transmitter include: regenerative crystal oscillator circuit capable of operating with any eight-megacycle crystal; input power of fifteen watts; send-receive operation without a relay; carbon microphone input to modulator; clamp-tube modulation; simple 'phone-c.w. changeover; and minimum current-drain requirements. If the design is followed faithfully, no one should have any difficulty in building or operating this transmitter.

DESIGN CONSIDERATIONS

In order to design a transmitter which could be duplicated in quantities of ten or more—as would be the case with any transmitter designed for civil-defense use—the transmitter had to be stripped of every non-essential part. This is true not only from the economic angle, but from the angle that the transmitters must be simple to build. Careful design work was required to reach this goal without sacrificing reliability, because reliability is even more essential than economy or simplicity. This requirement meant that commercial reliability had to be achieved with amateur constructional practices.

A simple transmitter circuit has many advantages. In addition to being easy to construct, such a transmitter is easy to service—far from a minor point when it becomes necessary for a person unfamiliar with the transmitter to do the repair job. Simple circuitry also adds another big advantage, that of simplicity of operation. A civil-defense transmitter may be operated by many different amateurs, so that an absolute minimum of exposed controls is desirable.

Easy to build, easy to service, easy on the pocketbook—yet, capable of 24-hour continuous operation. This states the designer's problem succinctly.

CIRCUIT DETAILS

Refer to the circuit diagram, Fig. 2. A 12AU7 miniature tube serves as the oscillator-doubler, and a GL-2E26 acts as the final r.f. amplifier. In the audio section, a 12AT7 acts as a two-stage speech amplifier, and a 6AV5-GT is the clamp-tube modulator.

Several types of oscillator circuits were tried and discarded before it was decided to use the one shown. Most of the circuits tried operated rather well, but the circuit used is the only one which gave ample output with every eight-megacycle crystal tried. Finicky circuits have no place in civil-defense equipment, hence the reason for the search for a reliable circuit. The oscillator circuit shown is a standard regenerative triode oscillator. Experience with this circuit indicates that it is not necessary to use special over-

Electrical Circuit

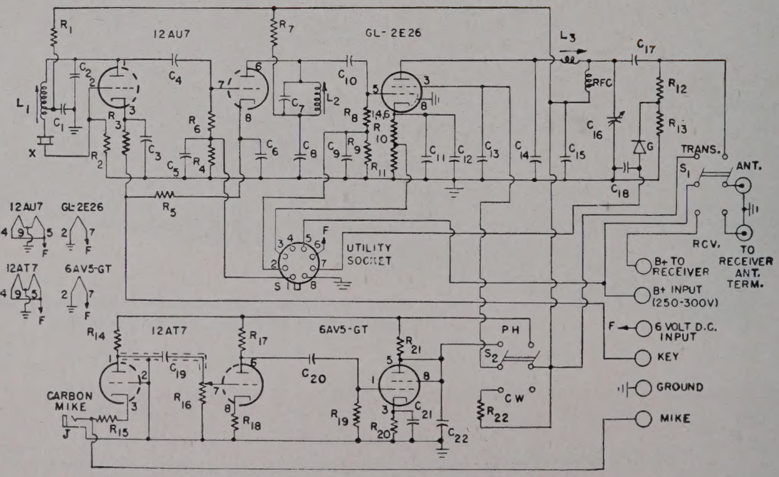

Fig. 2. Circuit diagram of 6-meter transmitter

one crystals—*any* crystal in the range 8.333 to 9.000 egacycles should operate properly.

For an exhaustive discussion of this and other sorts f regenerative oscillator circuits, the reader is re- erred to the article Overtone Crystal Oscillator Cir- uits, by E. P. Tilton, in the April 1951 *QST*. A point mphasized by Mr. Tilton in that article is worth epeating here. The frequency of the overtone is not n exact multiple of the fundamental frequency. For xample, a crystal with a fundamental frequency of .000 megacycles may oscillate on the third overtone t 24.020 megacycles. No information is available at is time on how much this variation may be; how- ver, experience with the transmitter being described ows that the variation is not too great. Further, entical crystals seem to change frequency by the ame amount. That is, three identical crystals (made y the same manufacturer) which have identical ndamental frequencies, will have overtone fre- uencies which are almost identical. A group of ystals for net operation will therefore be usable even n the overtone frequencies.

The oscillator shown in Fig. 2 operates on the third vertone. The resonant circuit, L_1 and C_2, is therefore esonant at the third overtone, which is approximately 6 megacycles. Regeneration in the circuit is con- olled by the position of the tap on coil L_1. This same oil is slug-tuned, allowing the circuit to be tuned for roper operation. The second section of the 12AU7 erves as a doubler, with output directly on the six-meter band.

The plate circuit of the doubler is tuned with a fixed capacitor and a slug-tuned coil. More than adequate output is obtained from the doubler to drive the GL-2E26. The doubler circuit is straightforward, and no regeneration is employed. Protective bias, supplied by R_5, prevents damage to the tube in the event of oscillator failure.

The final amplifier is capacitively coupled to the doubler plate circuit. The plate circuit of the GL-2E26 consists of a pi network designed to work into a 50-ohm load. Operating bias for this tube is supplied by a combination of grid-leak and cathode bias. When excitation to the final fails, either due to accident or due to keying, the cathode bias holds the plate current to a safe value. This value of cathode resistor (R_{10} plus R_{11}) will hold the cathode current to a relatively constant value whether excitation is applied or not. Hence, the current variation due to keying is slight, and voltage regulation is not a problem. This is an important feature, especially when vibrator power supplies may be used.

The cathode of the GL-2E26 is bypassed for r.f. as well as for audio frequencies, in order that degeneration at these frequencies is held to a minimum. No trouble was experienced with instability of the final amplifier due to parasitics or other forms of oscillation. Special care was taken to shield the output circuit from all other tuned circuits to minimize feedback. Fig. 1 shows how the GL-2E26 tank circuit is

CIRCUIT CONSTANTS

(All resistors and capacitors ±20% tolerance unless specified otherwise)

$_{1}$, C_3, C_5, C_6, C_8, C_9, C_{12}, C_{13}, C_{15}	270 mmf mica or general purpose ceramic
$_{2}$	40 mmf silvered-mica or zero-temperature coefficient ceramic
$_{4}$	25 mmf mica or general purpose ceramic
$_{7}$	10 mmf silvered-mica or zero-temperature coefficient ceramic
$_{10}$	100 mmf mica or general purpose ceramic
$_{11}$, C_{21}	50 mf 50 volt electrolytic
$_{14}$	20 mmf 1000 volt working mica
$_{16}$	65–320 mmf mica compression trimmer (El-Menco 303-M)
$_{17}$	1000 mmf mica or general purpose ceramic
$_{18}$	5000 mmf mica, paper or high-K ceramic
$_{19}$, C_{20}	1000 mmf mica or high-K ceramic
$_{22}$	500 mmf mica or high-K ceramic
	Crystal diode (G-E 1N48)
	Open-circuit phone jack
$_{1}$	14 turns No. 18 enamel wire, space wound to cover one inch, on Millen No. 69046 coil form. Tap at 4½ turns from the crystal
$_{2}$	6 turns No. 16 enamel wire, space wound to cover one inch, on Millen No. 69046 coil form.
$_{3}$	6 turns No. 16 enamel wire, space wound to cover ⅞ inch, on Millen No. 69046 coil form.

R_1	10,000 ohm, 2 watt
R_2, R_6, R_{13}	10,000 ohm, ½ watt
R_3, R_5	220 ohm, ½ watt
R_4, R_9, R_{18}	1000 ohm, ½ watt
R_7	11,000 ohm, 4 watt (two 22,000 ohm, 2 watt resistors in parallel)
R_8	22,000 ohm, 1 watt
R_{10}	*500 ohm, 4 watt (two 1000 ohm, 2 watt, ±10% resistors in parallel)*
R_{11}	47 ohm, ½ watt
R_{12}	15,000 ohm, ½ watt
R_{14}	22,000 ohm, 2 watt
R_{15}	100 ohm, ½ watt
R_{16}	0.5 megohm potentiometer
R_{17}	0.1 megohm, 1 watt
R_{19}	0.47 megohm, ½ watt
R_{20}	*750 ohm, 2 watt, ±10% (OR, two 1500 ohm, 1 watt, ±10% resistors in parallel)*
R_{21}	5,000 ohm, 10 watt
R_{22}	15,000 ohm, 20 watt (OR, two 30,000 ohm, 10 watt resistors in parallel)
RFC	6-meter r.f. choke (Ohmite Z-50)
S	Octal socket
S_1	DPDT non-shorting lever switch (Centralab No. 1454)
S_2	DPDT toggle switch
X	8.333 to 9.000 megacycle crystal

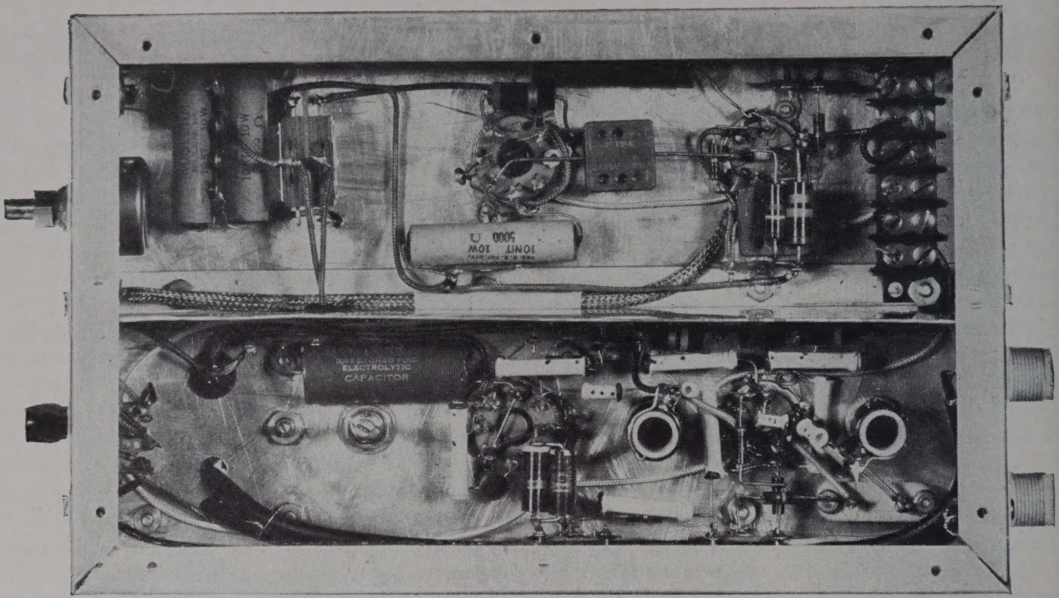

Fig. 3. Under-chassis view of 6-meter transmitter

mounted above the chassis.

The germanium diode, G, in the output circuit rectifies the r.f. signal and permits measurements to be made of the output voltage. It serves, therefore, as a tuning aid or as a monitoring point. This will be discussed in more detail later.

Provision for keying is incorporated into this transmitter. Again thinking of the civil-defense aspect, it is most desirable to be able to go to c.w. operation in case of an emergency, where a blown modulator tube could otherwise put the station off the air. The cathode circuits of both the oscillator and doubler section are keyed. No keying jack is used, but a terminal-board connection permits access to the keying lead. In normal operation the point marked "Key" is connected to ground.

Switch S_1 serves as the send-receive switch, and it handles the antenna switching as well as the high-voltage switching. In most transmitters of this sort a relay is used to do this job, but the relay cost can be eliminated and the current drain for the relay done away with if the proper type of switch is used. The switch specified is a lever-action "rotary" switch. The insulation on switches like this is adequate for r.f. insulation, and the contacts are capable of handling the r.f. current. Tests made with this transmitter have required more than 1000 operations of the switch, and there is no sign of contact deterioration at this time. In the "send" position the switch connects the antenna to the transmitter output circuit, and also applies the plate voltage to all parts of th transmitter. In the "receive" position the antenna i connected to the receiver, and the plate voltage i routed through the terminal board to the receive circuits.

The modulation system employed is of the clamp tube variety. Obviously, this type of modulation wi not produce as great a modulated signal as high-leve plate modulation, but, the big advantage of clamp tube modulation is that no transformers are require This was too big an advantage to be overlooked i the design of an economical, simple, civilian-defens transmitter. Because clamp-tube modulation is essentially a low-level type of modulation, the carrie amplitude is approximately 25 to 30 percent of tha obtainable from a high-level plate-and-screen modulation system.

A 6AV5-GT serves as the clamp tube. This is high perveance tube, originally designed as a horizontal-deflection amplifier for television receivers. high perveance tube means one which is capable c drawing a large current when relatively low plate an screen voltages are applied. The 6AV5-GT tube is a ideal tube for use as a clamp tube. With eleven watt of plate dissipation, it can handle sufficient power t do a good modulation job.

The clamp tube is driven by a two-stage R- coupled preamplifier using a 12AT7 tube. Microphon current for the single-button carbon microphone i obtained from the cathode circuit of the first ampli

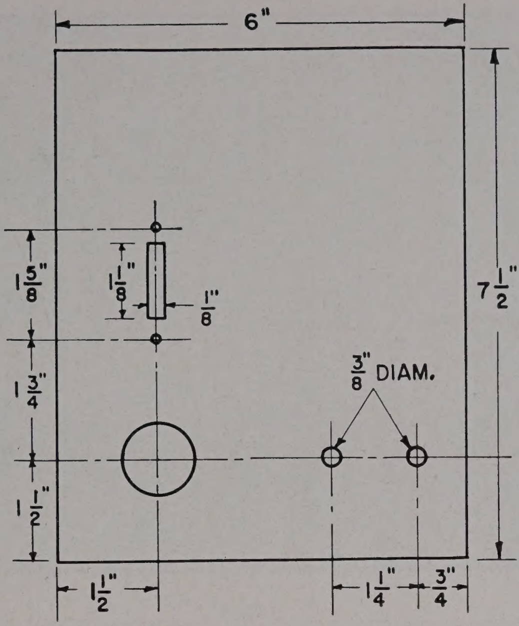

Fig. 4. Front-panel layout

r stage. Approximately eight to ten mils is adequate
r a carbon microphone, and this current is easily
andled by the 12AT7 tube. A potentiometer in the
id of the second amplifier stage serves as an audio
ain control.

Switch S_2 serves as the 'phone-c.w. switch. In the
w. position the voltage is removed from the audio
nd modulator tubes, and the screen voltage to the
L-2E26 is fed through R_{22}. For c.w. operation the
arrier output is approximately ten watts. The out-
ut for 'phone is about 5 watts.

The utility socket shown in the circuit diagram is
sed for three purposes. One, it serves as the connection
oint for the metering system; two, it serves as a pick-
ff point for auxiliary voltages; and three, it serves
s an input point for emergency-power connections.

Insofar as the metering problem is concerned, it
eemed pointless to provide the transmitter with a
illiammeter—even one which could be switched
om point to point in the circuit to read current
alues in all stages. From the economy standpoint, it
desirable to use a single meter and associated
witching circuits to serve a large number of trans-
itters. The diagram of a test-meter suitable for use
ith this transmitter is shown in Fig. 10. More com-
lete information on this metering system will be
iven in another paragraph. Of course, if a single
ransmitter is considered, it would be quite logical to
nclude the meter and the switching arrangement in
he cabinet with the transmitter.

Phone monitoring may be accomplished by connecting a pair of high-impedance headphones between pins 7 and 8 of the utility socket. It is thus quite easy to check the modulation of the transmitter, and, at at the same time, assure yourself that you are "on-the-air."

The utility socket also provides a convenient source of voltage. For example, if you need auxiliary illumination, you may connect a 6-volt bulb in the circuit by making connections to pins 6 and 8. Similarly, voltage may be provided for an auxiliary receiver, or any other equipment requiring filament voltage and plate voltage. Fig. 9 indicates how these connections may be made.

Used in a reverse manner, filament and plate voltage may be brought in on the utility socket, if, for any reason, the terminal board connections become unusable. Using the utility socket normally for such purposes is not recommended, however, as then it would be impossible to meter the various circuits in the transmitter.

CONSTRUCTIONAL DETAILS

From the photographs it is evident that a home-made chassis and cabinet has been used in the construction of this transmitter. The principal reason for this is that no commercial cabinet and chassis combination satisfied the designer's requirements. Further, the designer felt that it would be useful for a number of amateur requirements. The bugaboo of availability

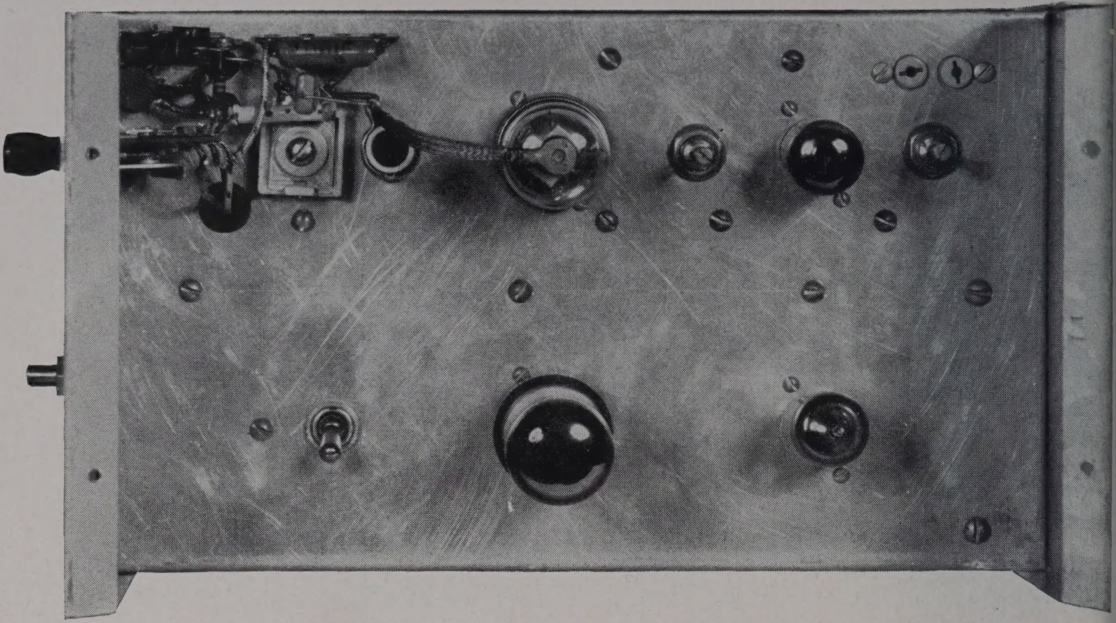

Fig. 5. Top view of 6-meter transmitter

need not be a problem, as this type of metalwork can be done by practically any sheet-metal shop. As a matter of fact, the chassis and cabinet design was deliberately held to the sort of work that could be done by a sheet-metal shop. As a further incentive toward use of a cabinet of this sort, the price is less than you would pay for an equivalent commercial product. The chassis and cabinet as shown should not cost more than $3.00 from the average sheet-metal shop. You have to do the paint job, of course.

In quantity lots of 20 or more, larger sheet-metal concerns can supply the chassis and cabinet shown, *completely punched with all holes to your specifications,* for less than $8.00.

The mechanical arrangement of the cabinet is very convenient when wiring the transmitter. The two ends (actually the front and back) are fastened to the chassis, as shown in Fig. 1. At this point it is very easy to mount all components, and then proceed with the wiring. The unit may be turned over when the under-chassis wiring is being done, and the front and rear panels act as "feet" to support the chassis. All parts are completely accessible when the top and bottom cover plates are removed.

Chassis size is ten by six by three inches. Material is 0.030 or 0.040 inch aluminum. Front and rear panel size is 6 inches wide and seven and a half inches high. Material is 20 gage iron. Bottom plate size is ten by six inches, and the material is 20 gage iron. The to cover piece is in the form of an inverted "U," and o a size that completely covers the box. The materia for the top cover is 22 gage iron. All pieces are hel together with sheet-metal (self-tapping) screws.

Layout dimensions for the top of the chassis an the front panel are shown in Figs. 4 and 6. Part mounting is not critical, although the r.f. sectio should be separated from the audio and modulato section by a shield, as shown in the bottom view o the transmitter, Fig. 3. In Fig. 6 only the majo holes are shown. The diameters of the socket hole will be determined by the type of socket used.

Note that the 'phone-c.w. switch is mounted o the chassis, and not on the front panel. Being protected in this manner, there is less likelihood that th switch could be actuated accidentally, by someon unfamiliar with the transmitter. For a similar reaso note that the audio gain control has a locknut on th shaft. Once this control is set, there is very littl reason for it to be changed. It is mounted on the fron panel, however, so that changes can be made easil when desired.

All tuning controls are available from either th top or bottom of the rig, with holes arranged in th bottom plate or top cover so that screwdriver adjus ments can be made easily. The microphone jack i placed on the front panel, but an auxiliary connectio

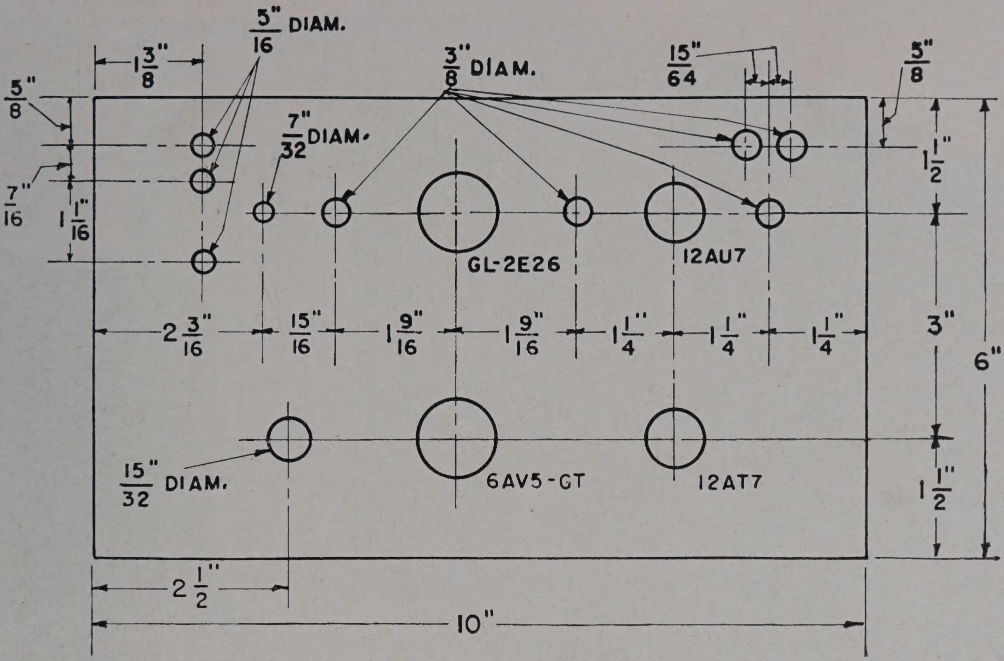

Fig. 6. Chassis layout

oint has been arranged on the terminal board, so at the microphone cord may be brought in the rear f the cabinet, and thus not clutter the operating ble directly in front of the rig. A hole is drilled in e rear of the transmitter cabinet so that all wires ay be brought through and connections made to the erminal board. Fig. 3 shows how this terminal board placed directly by the rear hole.

On the front panel will be found the microphone ck, the audio gain control, the utility socket, and e send-receive switch. The type of switch specified nder Circuit Constants actually is a three-position witch, with a center "off" position. This "off" posi- ion is a convenience, as it permits the user to remove he plate voltage from both the receiver and trans- itter, leaving on only the filament power.

Ventilation holes are provided on the top cover as hown in the photographs. Placed as shown, a chim- ey action takes place, and the cooling is very effec- ive. After four hours of operation, in a test where the late voltage was applied for about half the total ime, the top of the cabinet became just perceptibly arm. No part of the transmitter became hot.

In wiring the modulator, use shielded wire between he plate of the 12AT7 and the gain control. It was ot found necessary to shield the microphone lead rom jack to terminal board, although shielded wire or this connection may be used. Referring to Fig. 3, the terminal board connections are as follows, going from the connection nearest the center shield to the connection nearest the outside of the chassis: receiver B plus, 300-volt input, filament input, key lead, ground, and microphone connection.

COMPONENT PARTS

The parts listed under Circuit Constants are those which have actually been used in this transmitter. Some variation is allowable, obviously. The 270 mmf mica or general purpose ceramic condensers specified are all used for bypass purposes. Any value between 250 and 500 mmf would serve as well. In some cases a silvered-mica condenser has been specified, and this mainly for the sake of reliability. These or zero-temperature coefficient ceramics should work equally well. Condenser C_{14} is specified as a 1000-volt condenser. The actual voltage on this condenser should not exceed 600–700 volts, on modulation peaks.

The three coils (L_1, L_2 and L_3) have been wound on Millen No. 69046 coil forms. These forms are tuned with an iron slug. Any type of iron-slug coil forms should work, although the winding information given will not be correct if coils of a different diameter are used. The Millen coil forms have a diameter of one-half inch.

Use the specified value of resistance for R_{20}. If this resistance is too low the 6AV5-GT will draw too much

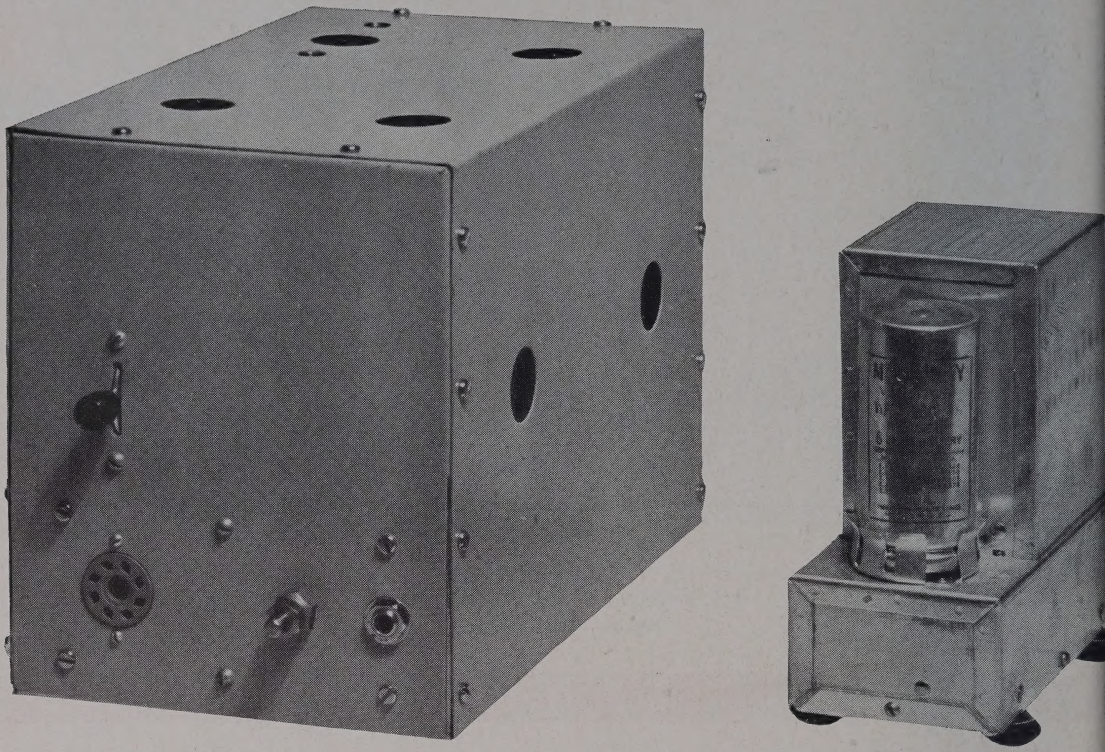

Fig. 7. Size comparison between 6-meter transmitter and its vibrator power supply

current, and if the resistance is too high, the GL-2E26 screen voltage will be too high.

METERING DETAILS

Fig. 10 gives the details of a suggested test meter. Basically, this consists of an 0 to 1 milliammeter and a two-pole, six-position switch, with three resistors to serve as voltage multipliers. This material may be mounted in almost any type of small metal box. No photograph is shown of a completed unit, because individual preference will determine the type of mechanical construction employed. The unit is provided with an octal plug on the end of a suitably long lead. When the octal plug is inserted in the utility socket on the transmitter, metering of all circuits in the transmitter is quickly accomplished.

In switch positions 1 and 2 the resistor R_1 causes the meter to act as a 0–10 volt voltmeter; in switch position 3, resistor R_2 makes the meter into a 0–5-volt voltmeter; in switch position 4, resistor R_3 forms a voltmeter with the range 0–1000 volts; in switch position 5, the meter is used as a 0–1 milliammeter in position 6 the meter is shorted (the recommende “off” position).

The following tabulation indicates the “current and voltage which the meter reads when it is switche to the various positions:

Position 1: Full scale equals 10 mils doubler gri current.

Position 2: Full scale equals 10 mils final gri current.

Position 3: Full scale equals 100 mils final cathod current.

Position 4: Full scale equals 1000 volts plat voltage.

Position 5: Relative power output reading.

Position 6: Off.

For accurate scale readings, the resistors specifie should be as accurate as possible. Strictly speaking however, accuracy is not paramount, inasmuch as th metering system will undoubtedly be used mainly a a tune-up aid.

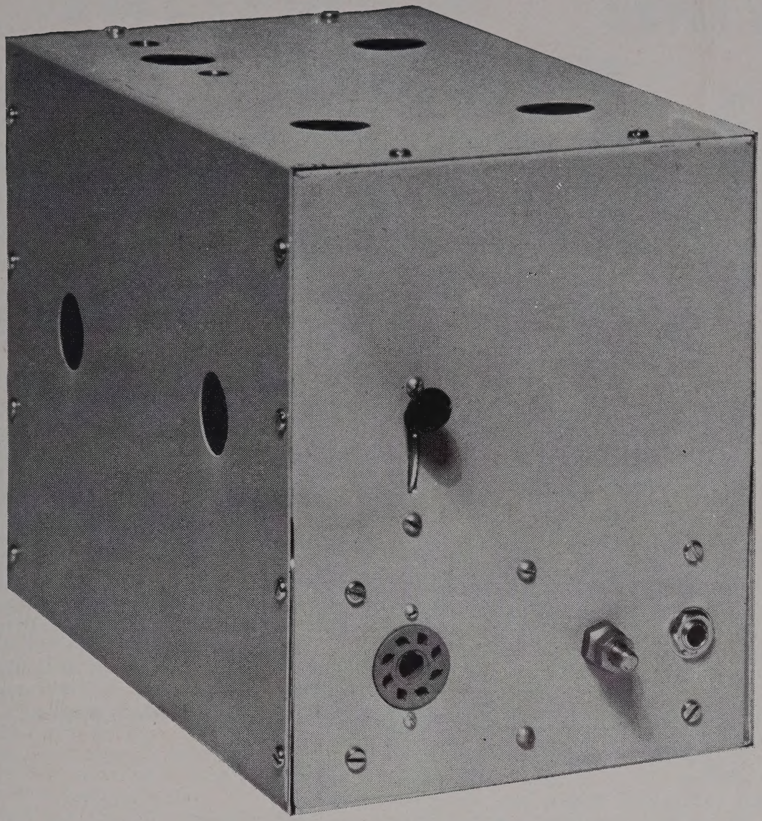

Fig. 8. Front-panel view of 6-meter transmitter

TUNE-UP PROCEDURE

Recommended procedure is as follows: Connect 50-ohm dummy load to the output connector. djust the loading condenser (C_{16}) for minimum loadng (maximum capacity). Insert crystal in crystal ocket, and turn on filament and plate voltage, makng sure that the send-receive switch is in transmit osition. Adjust L_1 to resonance, as indicated by maxinum grid current in the doubler stage. This current hould be approximately 2 to 3 mils. After L_1 is adusted for maximum doubler grid current, detune it lightly toward a higher frequency (turn slug so that is coming out of coil slightly). This detuning is the ame sort of thing that is done in tuning a convenional-type crystal oscillator, and is done to obtain naximum stability in the crystal stage.

If trouble is encountered with the crystal stage, he tap on the coil may be changed. As the tap is noved toward the plate of the tube the amount of egeneration is increased. If the tap is moved too far n this direction, the circuit will oscillate as a conventional L-C type Hartley oscillator, and oscillations will be present whether or not a crystal is in the circuit. If the oscillator is working properly, there will be no output when the crystal is removed from the socket. Also, tuning the circuit with L_1 will produce only minor changes in frequency.

Next, the doubler plate circuit should be tuned with L_2 for maximum final grid current. This current will be approximately 1.5 to 2.5 mils. Incidentally, in all this tuning procedure make the adjustments rapidly, while plate voltage is on, in order that the tubes will not be damaged due to excessive off-resonant currents.

The plate circuit of the GL-2E26 should next be

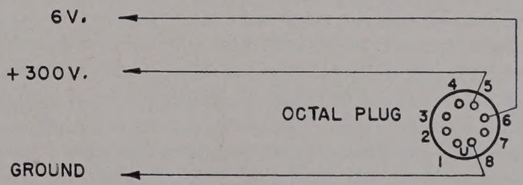

Fig. 9. Utility socket accessory connection

Electrical Circuit

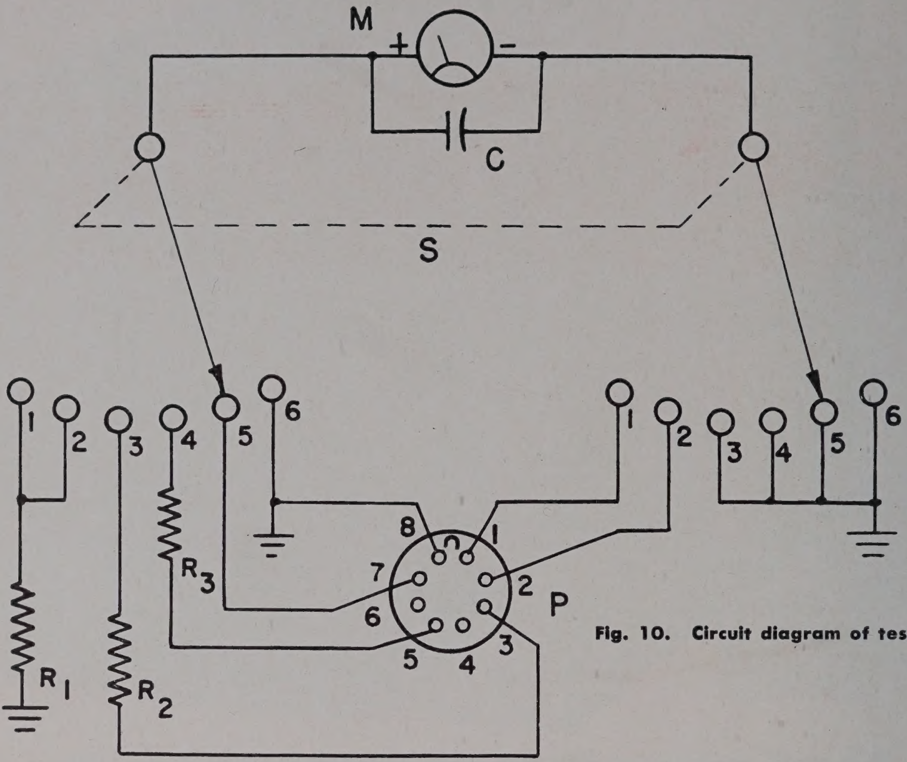

Fig. 10. Circuit diagram of test meter

CIRCUIT CONSTANTS

C	270 mmf mica or high-K ceramic
M	0 to 1 mil d.c. meter
P	Octal plug
R_1	10,000 ohm, ½ watt (see text)
R_2	5000 ohm, ½ watt (see text)
R_3	1 megohm, 1 watt (see text)
S	Two-pole, six-position rotary switch

resonated at 50 megacycles with L_3 by observing the cathode current, and adjusting for minimum current. The minimum cathode current will run around 30 mils. Next, decrease the capacitance of C_{16} to increase the loading, and retune L_3 for minimum current. Continue this process of decreasing C_{16} and re-resonating L_3 until the cathode current is approximately 45 to 50 mils. At this point the transmitter should be properly tuned.

To check modulator performance, couple an absorption type loop and pilot lamp to L_3 and modulate the rig. An increase in lamp brilliancy should be obtained as the rig is modulated, indicating upward modulation. If you find that you have downward modulation, indicated by a decrease in lamp brilliance as you speak, then check the grid drive to the final. If the current is over 2.5 mils, reduce it by slightly detuning L_2. This type of modulation requires heavy loading on the GL-2E26 plate circuit, and an optimum amount of grid drive. Following these adjustments, the antenna may be connected and the transmitte output and modulation again checked.

Remember that this transmitter is designed to wor into a 50-ohm load. This means that you should us an antenna whose impedance is approximately 5 ohms, or else couple into a tuning network with th same impedance. As a matter of fact, this transmitte can be coupled to a dipole antenna with a 70-oh impedance, or into a standard quarter-wave auto mobile antenna with a 36-ohm impedance, and th mismatch will not be serious. Feed the dipole wit 50- or 70-ohm line, and the quarter-wave antenna wit 50-ohm coaxial cable.

CURRENT AND VOLTAGE REQUIREMENT

Total filament current is 2.6 amperes, at 6 volt d-c or a-c. High voltage required is 250 or 300 volts High voltage current drain is approximately 100 t 110 mils for 'phone operation, and 60 to 75 mils fo c.w. operation.

SWEEPING *the* SPECTRUM

Some of you may be surprised at the emphasis hich the G-E *Ham News* has been placing on civil-fense work. Many of you readers are grateful for e work already done, as shown by your letters, but have the feeling that other amateur groups may onder why so much space is being devoted to civil-fense equipment. Frankly, it is my opinion that il-defense communications is the biggest challenge at has been put to the amateurs in many years. There is no community in the United States that s too much communication equipment, or too elabate a communication system. In fact, some comunities have no system at all. Radio amateurs are mmunication specialists, by the very nature of their ork, and it seems criminal to waste this talent. Untunately, there is a little of the "it can't happen re" philosophy in many amateur groups. It is not at these amateurs don't want to help, but they are t yet convinced that there is a good reason for king a part in civil defense planning.

Probably nothing I can say here will convince the ubters of the seriousness of this problem. However, would like to ask you to lend a sympathetic ear enever you are approached by your local civil-fense authorities. These people look to you, the ateurs, as communication specialists. If you, individually, fail to measure up to these standards, then u hurt amateur radio as a whole. The challenge is ere. It is up to each of us, as individuals, to meet is challenge by aiding in whatever way possible.

* * *

I'd like to ask you a question. Would you like to e a future issue of the G-E *Ham News* describe a -meter receiver which is the companion unit to the -meter transmitter described in this issue? This ceiver is mounted in a cabinet identical in size and pearance to that shown for the transmitter. Actuly, the receiver is a stripped-down version of the e that appeared in the September-October 1951 *am News*. It is a superhet with the same tube line-, but several circuit changes have been made. You ight call it a down-to-business, point-to-point comunication receiver for six-meter civilian defense ork.

If you would like to see this in a future *Ham News*, op me a postcard. The address is Lighthouse Larry, ldg. 267, General Electric Co., Schenectady 5, ew York. I'd like to have your vote before February , if possible. Here's your chance to vote on what u want to see in *Ham News*. Whether you vote es" or "no," send in those postcards.

* * *

Finding some components hard to get these days? 's not unusual, because the military is taking an er-increasing amount of material, and the manufacturers are finding it difficult to keep up with the demand. You, as an amateur, need not let this trouble you if you remember to use your priority. On October 4, 1951 the National Production Authority issued a new order designed to keep amateurs on the air. This order grants priority assistance to licensed amateur radio stations.

When you need materials, such as copper, aluminum, and other metals or raw materials, use the allotment symbol MRO on your order, and certify it by signing your name and station call letters on the order. For component parts, use the symbol DO-MRO in the same way. Amateurs are limited to an annual quota of $100 in rated orders, unless they are members of one of the major military or emergency networks, in which case the annual quota is $200. These organizations include: MARS, RACES, NTS (ARRL), Flood Emergency Network, National Emergency Net (ARC), CAP, USNR Communications Network, and ARRL Emergency Corps.

In order to preserve your quota, use the priority symbol only on those orders where a priority is required. The quota refers to orders bearing the priority symbol, and does not refer to your total purchases in any given year.

* * *

One question which has been asked quite often by the local ham gang concerns license renewals. The question is this: If I have applied to the F.C.C. for renewal of my license before the expiration date, but have not heard from them, is it legal for me to continue to operate after the expiration date of my license? In case you have this problem, the answer is yes. You may continue to operate past the expiration date of your license, if you applied for renewal before the license expired.

* * *

Dr. W. R. G. Baker, General Electric Vice-president, recently spoke before the National Electronics Conference on the subject "Electronics for Defense." One of his remarks was touched with the type of humor that a radio amateur might appreciate, so I'm going to repeat it. This remark was prefaced by statements having to do with the military's demands for equipment which could be considered as extremely rugged, completely standard, and as small as possible.

Dr. Baker went on to say, "What the military dreams of is such things as a gunfire computer rugged enough to be tossed out of an airplane at 5000 feet without a parachute, small enough to be carried in a vest pocket, and simple enough to be operated by someone who failed to graduate from the third grade, which can be disassembled and reassembled at midnight under three feet of water."

—Lighthouse Larry

BEAM POWER TUBE

DESCRIPTION

The GL-2E26 is a five-electrode beam power amplifier tube designed for use in FM transmitters, either i low-power driver stages, or in the output stage when only low power output is required. It is also useful i audio-frequency power and modulator service. The anode is capable of dissipating 13.5 watts, and cooling i accomplished by radiation. The cathode is the indirectly heated type. Maximum ratings apply up to 125 megacycles.

The 2E26 has high power sensitivity and high efficiency and can be operated at relatively low plate voltag to give large power output with small driving power.

The base of this tube has a short metal sleeve which shields the input to the tube so completely that n other external shielding is required. Separation of input and output circuits is accomplished by bringing th plate lead out of the bulb to a cap opposite the base.

GENERAL CHARACTERISTICS

Number of electrodes	5
Electrical	
Heater voltage, a-c or d-c	6.3 volts
Heater current	0.8 ampere
Transconductance, $I_b = 20$ ma	3500 micromhos
Grid-screen amplification factor	6.5
Interelectrode capacitances*	
Grid-plate	0.20 micromicrofarad
Input	13 micromicrofarad
Output	7 micromicrofarad
Mechanical	
Mounting position—any	
Net weight, approximate	1½ ounce

* With no external shielding and base sleeve connected to ground.

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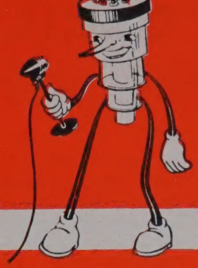

ARCH—APRIL 1952

VOL. 7—NO. 2

OSCILLATOR-MONITOR

Phone—CW Monitor and Code Practice Oscillator for Novice or Oldtimer

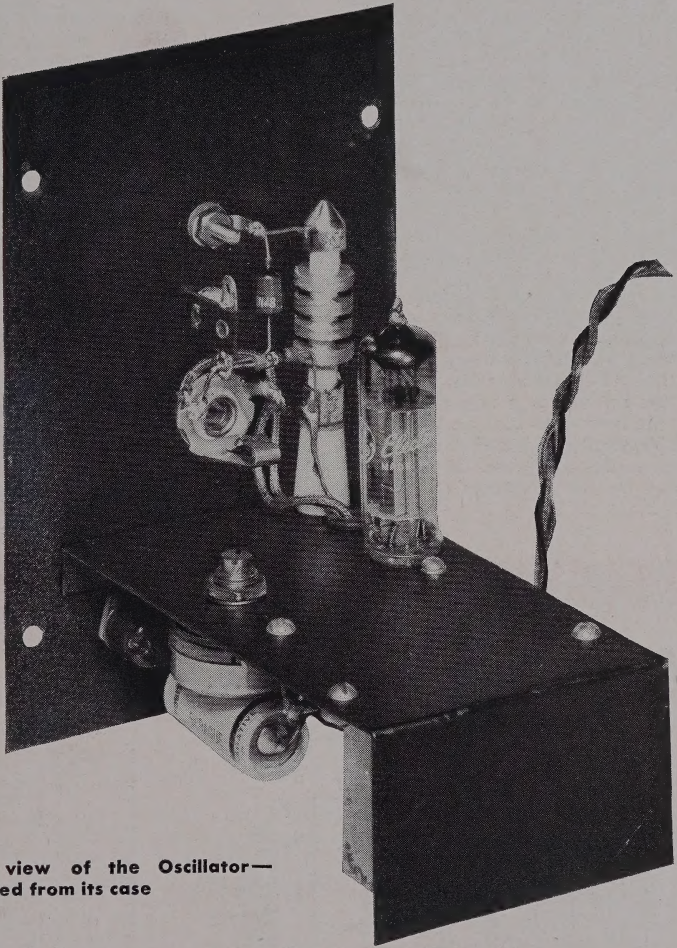

Fig. 1. Rear view of the Oscillator—Monitor removed from its case

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Tricks & Topics........page 5
Designer's Corner........page 6
Sweeping the Spectrum........page 7
Technical Information (1N48)........page 8

OSCILLATOR-MONITOR

This monitor enables the c.w. operator to hear his own keying, and it allows the 'phone operator to constantly listen to his modulated signal. Also, this device can serve as an audio oscillator, which may be used for code practice work or for m.c.w. operation. This Oscillator-Monitor would be especially useful to the beginning amateur, as it could be used for code practice work in the beginning, and serve as either a 'phone or c.w. monitor after the station was built and on the air.

ELECTRICAL DETAILS

With reference to the circuit diagram, Fig. 2, it will be seen that a single 6BN6 tube is employed. This tube is a 7-pin miniature tube of recent design, and is known as a gated-beam tube. While similar in appearance to regular receiving tubes, the 6BN6 is actually a new species of tube, with several interesting characteristics. For example, this tube is capable of cutting off its own plate current with its own self bias.

In the Oscillator-Monitor circuit the 6BN6 is used in this manner. A portion of the tube operates as an audio oscillator. Another section of the tube is triggered by an incoming r.f. signal so as to allow the audio frequency note to pass through the tube to the output circuit. This action provides monitoring action for c.w. operators. For use as a code-practice oscillator, the keying circuit triggers the tube, rather than the r.f. signal, and again the output circuit receives the audio tone. For 'phone work, the oscillator section is put out of action, and the tube acts as an audio amplifier.

Refer again to Fig. 2. When switch S is open, and no r.f. signal is present on grid 3, the following occurs. Grid 2 is supplied with approximately 80 volts through the transformer, T. The resulting current flows through the cathode bias resistor R_3, and the voltage drop across this resistor is a bias sufficient to stop the plate current flow. The bias on grid 1 is adjusted, by means of R_3, until grid 1 and grid 2 form a negative transconductance oscillator. The exact frequency is determined by the constants of T, C_2, C_3 and R_2.

Now, even though this section is oscillating, no audio output will appear in the plate circuit because the tube is supplied with cutoff bias. However, we can overcome this bias by connecting the cathode of the tube to grid 3. By placing a key between these two points the audio tone is passed on to the plate circuit and a code oscillator is formed. We can accomplish the same action and again overcome the cutoff bias by means of the r.f. signal. In this case the signal is picked up by the antenna post, is rectified by a germanium diode, and the resulting d.c. bias triggers the tube and passes the audio tone through to the plate circuit. If the r.f. signal picked up is a keyed signal, then the audio tone appearing in the output circuit is a faithful reproduction of the signal being transmitted. Note that this monitor is actuated from the r.f. signal itself, so that if you hear an audio tone, you know that the transmitter is actually on the air.

For 'phone monitoring, switch S is closed, which stops the oscillation between grid 1 and 2. Now, the germanium diode, G, acts as a detector to remove the audio intelligence from a 'phone signal, and the 6BN6 acts as an audio amplifier.

CONSTRUCTIONAL DETAILS

The unit shown in the photographs contains no power supply. One could be built to use with the Oscillator-Monitor, but the power requirements are so low that most builders will want to supply power from a source already available. The voltage required is 80 to 300 volts, and the current drain is approximately 10 ma. For battery operation, 90 volts is recommended.

Referring to the photographs, the unit is built in a 4 by 5 by 6 inch utility cabinet. The one shown (ICA No. 3819) has a handy shelf attached to the front panel which serves as the chassis. Parts placement is not critical, but the layout shown is a tried and tested mechanical arrangement. As shown in Fig. 3, the antenna post, the keying jack (J_1), the output jack (J_2) and the switch are placed on the front panel. Jack J_1 is just below the antenna post.

Electrical Circuit

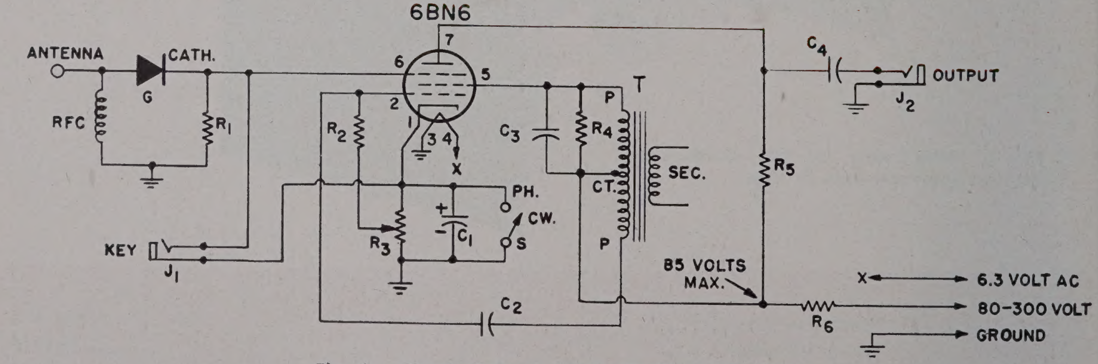


Fig. 2. Circuit diagram of the Oscillator-Monitor

The cathode bias resistor, R_3, is mounted on the assis and is provided with a screwdriver slot for justment. Once this control is set no further anges are required in the setting unless another be is used. Fig. 1 shows how the r.f. part of the cuit is mounted above the chassis. All other parts mounted under the chassis. A hole must be pro- led in the rear of the cabinet to pass the three-wire wer cable.

The antenna post and the keying jack must be ulated from the front panel. This may be accom- shed with fiber washers. The output jack does not uire insulation, but make certain that condenser C_4 nnects to the ungrounded terminal of this jack.

The germanium diode, G, is connected as indicated. ost diodes are marked with a line around one end. is end is the cathode end, and should connect to R_1, the circuit diagram indicates.

Transformer T is a standard universal output nsformer. The secondary is not used. The primary connected as indicated, using the push-pull con- tion, with one plate end going to pin 5, the other ite end going to C_2, and C_3 and R_4 connected from center-tap to the plate end which connects to 1 5.

In the circuit diagram you will note that a maxi- um voltage of 85 volts may exist at the junction of and R_6. This is very important. If too much voltage applied to grid 2, the tube will not operate in the ended manner, and it may be damaged. Resistor is intended to drop the voltage to approximately volts when 300 volts is applied externally. If you end to use an external source of voltage which is ver than 300 volts, then R_6 may be made smaller. r example, if you use 100 volts, R_6 could be 1500 ms. Whatever the external voltage may be, use a lue for R_6 which will reduce the voltage on the ner side of R_6 to at least 85 volts, and you may go low as 50 volts at this point if you wish.

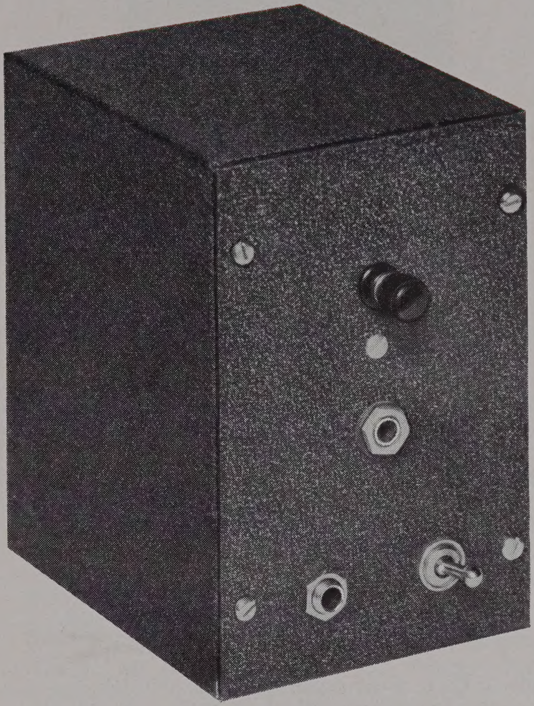


Fig. 3. Front view of the Oscillator-Monitor

CIRCUIT CONSTANTS

(All resistors and capacitors ± 20% tolerance unless specified otherwise)

C_1	10 mf 50 volt electrolytic (Sprague TA 510)
C_2	1000 mmf mica or ceramic or paper
C_3	6000 mmf mica (see text)
C_4	0.05 mf paper
G	Crystal diode (G-E 1N48)
J_1, J_2	Open-circuit phone jack
R_1, R_5	0.1 megohm, ½ watt
R_2	0.47 megohm, ½ watt
R_3	500 ohm potentiometer
R_4	33,000 ohm, ½ watt (see text)
R_6	22,000 ohm, 2 watt (see text)
RFC	2.5 mh r-f choke (Millen No. 34100)
S	SPST toggle switch
T	Universal output transformer (Stancor A-3823)

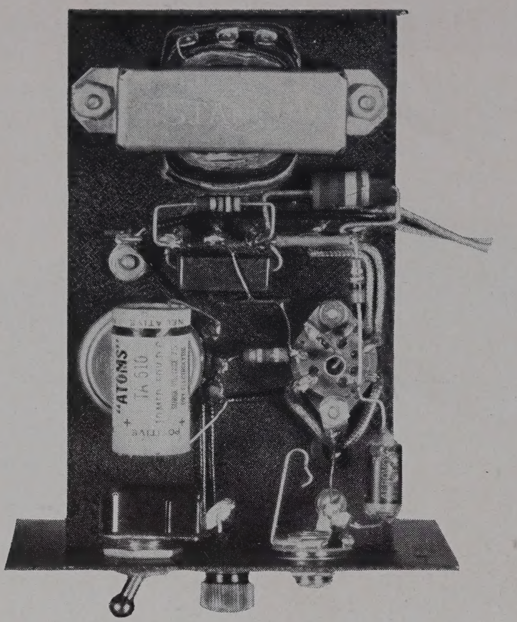


Fig. 4. Under-chassis view of the Oscillator-Monitor

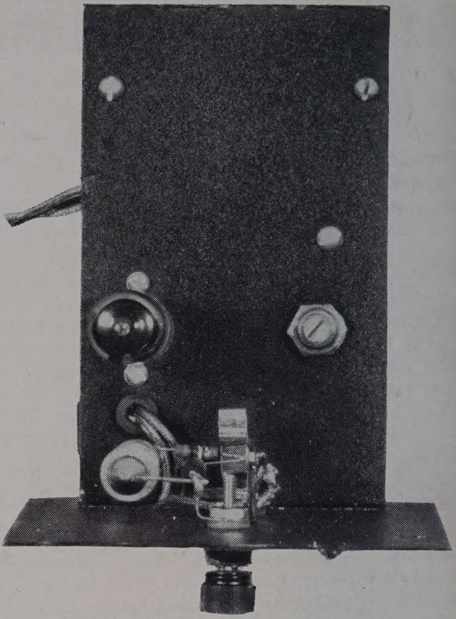


Fig. 5. Top-chassis view of the Oscillator-Monito

TUNE-UP ADJUSTMENTS

After the unit is completed, connect 6.3 volts a.c. between ground and the filament connection wire. Next, connect the high voltage with the negative connection to ground and the positive connection to the lead marked 80–300 volts. Make certain that switch S is open (in the c.w. position).

Plug a key in the key jack and close the key. Insert a pair of earphones in the output jack, and listen for an audio note. Adjust R_3 until you get a good, clear note. Try the key to make certain that the note can be keyed.

If the note is the wrong tone, change the value of C_3. A larger value will give a lower tone, and a smaller value will give a higher tone. The value specified will produce a satisfactory tone with the transformer specified, but if another type of transformer is used, it may be necessary to change the value of C_3 until a pleasing tone is obtained.

If you do not obtain a tone with the key closed, change the value of R_4 to a higher value, say 50,000 ohms. If you obtain a tone regardless of whether the key is closed or not, change R_4 to a lower value, and keep decreasing the value of R_4 until the tone no longer appears when the key is open.

The unit should now be in operating order. To check the operation as a monitor, place an antenna on the antenna post. This may be a piece of wire whose length depends upon the power of the transmitter being monitored. If you are using a low-power transmitter, you may need to run the wire near the antenna feedline in order to get enough energy to trigger the unit. Do not use any more wire for an antenna than is absolutely necessary because it is possible to overload the monitor. When the monitor is overloaded it will not oscillate. When you have the proper amount of pickup, an audio note will appear in the earphones when you key the transmitter.

If the transmitter does not seem to trigger th unit, you may have the germanium diode connecte in backwards. Reverse the connections in this case.

In order to make the unit more sensitive to r.f signals, the r.f. choke may be replaced with a tune circuit. Generally this will not be necessary, and th circuit as shown should work on almost any amateu band.

For 'phone monitoring you may test the unit b modulating your transmitter, and checking to see i the voice is heard. Switch S must be closed for 'phon monitoring. If you live close to a local broadcastin station you may find that you will hear this station This is to be expected, because the monitor is workin as a monitor for the local broadcast station. If th station is loud enough to be troublesome, you ma have to put a wavetrap in the antenna circuit.

USING THE OSCILLATOR-MONITOR

When used as a 'phone monitor, earphones mus be employed. However, when the unit is used as keying monitor the earphones may be replaced wit a small speaker and matching transformer. A universal output transformer with its primary connecte to the output jack will serve nicely. It is also possib to feed the output of the monitor directly into th audio input of the receiver in use, and thus tak advantage of the audio amplifier and speaker in th receiver. In this way the received signal will be hear on the receiver when you are in contact with som amateur, and your own signal will be fed into th receiver through the monitor when you are transmitting. No switching is required, although som means must be used to make the receiver insensitiv to your own transmitted signal.

Tricks & TOPICS

How did you solve that last problem that almost had u stumped? Be it about tubes, antennas, circuits, etc., hthouse Larry would like to tell the rest of the hams out it. Send it in! For each "trick" published you win 0 worth of G-E Electronic Tubes. Mark your letter ntry for Tricks and Topics" and send to Lighthouse Larry be Division, Bldg. 269, General Electric Company, henectady, New York, or in Canada to Canadian General ectric Company, Ltd., Toronto, Ontario. The Companies all have the right, without obligation beyond the ove, to publish and use any material submitted to is column. No entries returned.

OLD TUBES AS BLEEDERS

Out-of-date transmitting triodes, or extra surplus-rchased triodes can be made to serve quite easily high wattage bleeder resistors. A tube with a plate ssipation of fifty watts can be used as a fifty-watt eeder resistor, for exnple.

Such tubes may be used follows. Connect the ament center-tap to a elf-bias resistor and ence to B minus. Conect the anode to B plus, id the grid to B minus. se a spare filament transrmer to supply the noral filament voltage.

The value of the resistor ould be such as to perit the desired bleeder rrent to be drawn when the power supply is operatg. This current times the power-supply voltage ould not exceed the dissipation rating of the tube.

For example, a GL-203-A tube has a plate dissipaon of 100 watts (the maximum CCS dissipation ting). If used as a bleeder on a 1000-volt power ipply, a 50-ohm, 2-watt resistor will provide a bias f approximately minus 5 volts, and a current of 100 iils will flow. This is the maximum current which iay be drawn and still keep the tube within the issipation rating at 1000 volts. A larger value of esistance may be used if a lower current is desirable.

When the tube characteristics are unknown, the alue of the bias resistor may be determined experientally. Be sure to provide a resistor of sufficient ower rating so that the bleeder current squared times he resistance is well within the resistor wattage ating.—W2KUJ

HOMEMADE TOOL FOR TWINLEAD

A very handy cutting and stripping tool for twinead can be made from a pair of old scissors. Refer to ig. 6. Procure a pair of old household scissors, or an nexpensive pair of children's scissors. About one nch from the pivot point file or grind a V in each lade, so that when the blades are closed a little bit of light can be seen through the blades. Next, enlarge his area with a file or drill until you have a hole which is slightly larger than the diameter of the twinead wire. Now, file or grind a slight angle on the ides of the V's to form a good cutting edge. Finally, grind off the end of the scissors so that there is about one-half inch of blade from the center of the V's o the end of the blades.

The portion of the scissors from the V back to the pivot is normally used to cut the twinlead, and the front portion is used, with the V itself, to cut the nternal portion of the insulation and to strip the wire. The hole at the middle of the V portion straddles the wire and acts as the stripper.—W8TIC

MICROPHONE JACK SHIELD

Here is a simple and economical way to completely shield the microphone input jack on speech amplifiers. Procure one of the small aluminum screw-top cans in which each 35 mm. camera-film cartridge comes packed. Place the cap on a flat surface and with a small hammer, from the inside, pound out the small dome so that the top is flat. Then, drill a hole in the center of the cap and mount it directly on the rear of the microphone connector. If desired, a small hole can be punched with an icepick in the side of the cap near the top to permit the exit of a ground lead. If this is done, be sure the hole is above the threads.

Finally, cut a hole in the center of the bottom of the can, insert a rubber grommet, and you are finished. Plenty of room is provided inside the can for the grid resistor, and the bottom is easily unscrewed when access is desired.

The best way to make the holes in this thin aluminum stock and avoid jagged edges is to first drill a small hole and then enlarge it with a rat-tail file.—W9TUI

CHASSIS LAYOUT TRICK

Here is a trick that I think will save you time when you do that next layout job. Procure some cross-section paper (graph paper) from a stationery story, and fasten this paper to the bare chassis with transparent adhesive tape. Try to get the type of graph paper that is divided by inches and tenths of inches.

The uniform markings on the paper act as a guide so that you can get a uniform layout. Also, you can visualize the size of the space occupied by various components, and avoid a crowded layout. The paper also protects the chassis from fingermarks and oil from your tools.—W1RQC

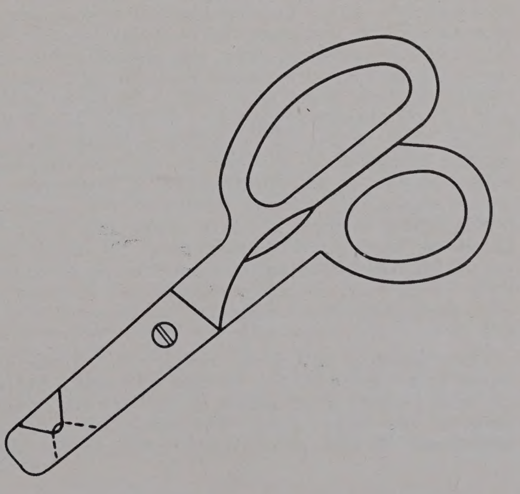


Fig. 6. Scissors arranged as per suggestion of W8TIC

Designer's CORNER

Notes on Designing a Power Supply

This is not intended to be a deep technical discussion, but merely a clear, easy-to-follow description of how to select the right components for a power supply. For the reasons behind the statements about to be made you are referred to any amateur handbook. A power supply circuit is relatively simple, but unless certain fundamental rules are observed, the results obtained will not always be satisfactory.

The first two questions to be answered are: 1) do I need exceptionally good regulation? and, 2) how much ripple voltage can I tolerate? Both of these questions can be answered simply if you know the use to which the power supply will be put.

You will need good regulation if the current drain from the power supply is variable; that is, subject to change while in use. Examples of this sort of service would be power supplied to a class-B modulator stage, to class-B linear amplifier stages, or to the stages in a c.w. transmitter, including the keyed stage. On the other hand, if you are supplying voltage to a buffer stage in a 'phone transmitter, then regulation is not too important, because the current drain will be constant.

The question on ripple is just as easy to answer. For any stage in a c.w. transmitter, 5% ripple can be tolerated. For any stage in the r.f. section of a 'phone rig, except the modulated stage, 5% ripple is satisfactory. However, for the modulated stage itself, the power supply should have 0.25% ripple, or less. The audio stages should similarly have less than 0.25% ripple applied to them, except for the class-B modulator, where 5% ripple is satisfactory. In the case of high-gain audio amplifiers, as low as 0.1% ripple is desirable. This figure of 0.1% ripple applies also to power supplies used with receivers.

The ripple requirement determines the filtering necessary. A one-section filter ordinarily is used to reduce the ripple to 5%, but it is not usually economical to try to get much more reduction than that with a one-section filter. Considering full-wave circuits, where the ripple frequency is 120 cycles, five-percent ripple will be obtained when the product of inductance (in henrys) and capacitance (in mfd) equals twenty. A choke input filter with a 10-henry choke and a 2 mfd condenser will give 5% ripple. To achieve further ripple reduction a multiple-section filter is usually employed. A two-section filter of this sort might consist of an input choke, a condenser, a second choke, and another condenser. For example, if you added another 10-henry choke and a 4-mfd condenser to the filter constants given above, the overall filtering action would reduce the ripple to less than 0.2 percent. (Most handbooks tell you how to compute the ripple for other combinations of L and C.)

The regulation of a power supply, that is, the relation between the output voltage at no load and at full load, is determined almost entirely by the inductance of the input choke. The *minimum* value of inductance at this point which prevents the d.c. output voltage from rising above the average value of the a.c. voltage being rectified is called the *critical inductance.* Conservative design indicates the use of a choke having a value at least twice the critical inductance.

The critical inductance, in henrys, for 120 cycle ripple is determined by dividing the load resistance by 1000. For example, a load of 1000 volts at 40 mils (the bleeder current, or minimum current only) gives a load resistance of 25,000 ohms. In this case, an input choke of 50 henrys would give excellent regulation characteristics (twice the 25 henrys critical inductance).

If you find that this value of inductance is too great a drain on the pocketbook, a lower value can be used if the bleeder current is increased. For example, an 80 mil bleeder will result in a critical inductance of 12.5 henrys, so that a 25-henry choke would be desirable. Note that the input choke need have this high value of inductance only at the minimum (bleeder) current. Swinging chokes are widely used for this reason.

Check the value of the bleeder in your present power supply, and see if you have one which is drawing sufficient current!

At this point in your thinking you are ready to select components for your power supply. You select an input choke of the calculated value with sufficient current rating to handle both the bleeder current and the useful load current. Next, select a condenser to give the required reduction in ripple when used with the input choke already selected (choose these values to avoid resonance at the ripple frequency—your handbook gives details). A second section can be selected if ripple requirements demand it. The bleeder resistor is determined as mentioned in the previous paragraph.

Next, compute the voltage drop across the choke or chokes, and add to this the voltage drop across the rectifier tube. Now add the desired output voltage and multiply by 1.1 to get the value of a.c. r.m.s. voltage required from center-tap to one side of the transformer. For example, if the load current is 200 mils, the bleeder current 40 mils, and desired output voltage 1000 volts, compute the drop across the chokes due to 240 mils current (say this is 24 volts) add tube drop (say 15 volts for mercury-vapor tubes) and you get 1039 volts. Multiply by 1.1 and you get 1143 volts. You therefore want a transformer with a secondary voltage rating of 1143-0-1143, and with a current rating of approximately 250 mils. This transformer will supply a d.c. output voltage of 1000 volts and a useful current of 200 mils, in the power supply you just calculated.

Some transformers are rated for *d.c. output voltage* rather than for a.c. voltage. In this case the transformer manufacturer has already calculated the d.c. output voltage from a typical filter system. Just make certain that you know how the transformer is rated before you use it.

—*Lighthouse Larry*

SWEEPING *the* SPECTRUM

I recently received a very nice letter from W9ONY, sident of the Milwaukee Radio Amateurs' Club, which Fred expressed his appreciation to G.E. for film *And a Voice Shall Be Heard.* To quote him: he membership was thrilled over it and it certainly sents a vital message to all." This film, prepared The March of Time for G.E., gives the story of il defense in Onondaga County, New York. The t of the radio amateur is very well presented.

If you would like to arrange to show this film to ur local club, a copy may be borrowed from one of eighteen G.E. film libraries throughout the ntry. You can get the address of the nearest rary by writing to your local G.E. office, or, by pping me a note. The running time is approxi-tely 20 minutes, and the film is 16 mm. sound. If u think your local civil defense office would be in-ested, ask one of the officials to drop in at your wing—he might wish to arrange to borrow the n for a general civil defense meeting.

* * *

Have you seen any lampshades around your town? e type I'm talking about wouldn't be inside a use, but would be mounted outside on a steel le in some clear area. If there aren't any lightbulbs ide these lampshades, then the chances are that ey are special radiation detectors, made to determine quickly and accurately the position of an atomic mb explosion.

These radiation lampshades have been designed a group of people in Schenectady, many of them ployed in General Electric Co. The Schenectady unty Civil Defense authorities have already in-lled a complete system of these detectors in the unty.

The lampshade determines the height at which a mb has exploded and the position of ground zero—e point directly under the blast. The device is made sheet metal, about a foot in diameter, smaller at e top than at the bottom, and is painted white in-le and out. On the inside, numbered vertical lines d horizontal lines are painted. A pointed brass rod ojects upward inside the lampshade.

During an actual bombing, intense heat radiation uld scorch the inside painted surface in relation to e direction of the burst, forming an unscorched adow of the vertical rod. The position of the shaw gives information as to direction and height of e bomb burst. Readings taken from several lampades can be correlated to give exact information.

Why talk about lampshades? Well, it seems to me that a couple of ham mobile rigs would be the ideal way to get the information back to Control Center in a hurry, where the plotting can be accurately completed.

* * *

Speaking of red-hot temperatures, the engineers in the Schenectady vacuum-tube plant recently had a problem which electronics solved for them. In making ignitrons (a special type of heavy-duty rectifier) it is necessary to heat some of the tube parts to rather high temperatures. However, just any temperature won't do, and the exact temperature is important to tube quality.

The solution was found in a G-E electric eye unit, which controls the temperature of the glowing graphite crucibles as they are heated to a temperature of approximately 3500 degrees Fahrenheit. At this temperature the graphite is a dazzling white color. The control unit is able to maintain temperatures in this range with an accuracy of 15 degrees.

You'll probably never want to know the temperature of the anode in your final tubes, but if they are running in the red-hot to white-hot range, you could read and control this temperature by using this G-E device.

* * *

A news release that passed over my desk recently told of the completion of a number of radar picket posts that have been installed by G.E. for the U.S. Air Force. The location and number of these posts is secret, according to G-E officials, but some of the unclassified information is quite interesting.

These radar installations are capable of detecting aircraft at long range, and are now protecting the U.S. and Canada against sneak enemy air attack. Installations in the Artic regions are housed in rubberized fabric "radomes," supported entirely by air pressure, and resembling huge pumpkins.

An estimated 400 men are required to operate each installation, on a 24-hour basis. Imagine what a ham could do with an arrangement of that sort, especially if it was designed for DX work! With 400 helpers, one ought to be able to work at least 100 countries in an afternoon. Of course, you'd have to call it a multiple-operator station!

It's a comforting thought to know that these radar installations are now at work protecting our borders —serving as the outposts of our civil defense organization. What are you doing for civil defense these days?

—*Lighthouse Larry*

Technical Information 1N48

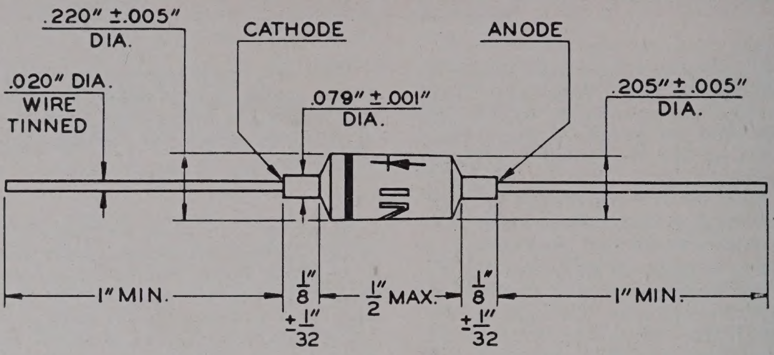
GERMANIUM DIODE

GENERAL DESCRIPTION

The IN48 is a general-purpose germanium diode which exhibits a medium back-resistance characteristic and has a medium inverse voltage rating. The IN48 is designed for most low-current power-rectification applications such as isolation, clipping, switching, and meter rectification.

Mounting Position . . . . Any

PHYSICAL DIMENSIONS



MAXIMUM RATINGS

AT AMBIENT TEMPERATURE OF +25 CENTIGRADE

Peak Inverse Voltage	85	Volts
Continuous Inverse Voltage	70	Volts
Average Rectified Current	50	Milliamperes
Peak Rectified Current	150	Milliamperes
Surge Current for 1 Second	400	Milliamperes
Ambient Temperature Range	–50 to +75	Centigrade

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Ham News

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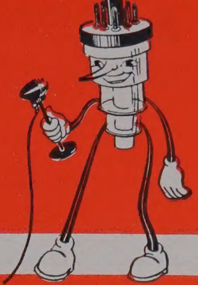


AY—JUNE 1952

VOL. 7—NO. 3

6-METER CD RCVR

Specialized Six-tube Superhet for CD Use

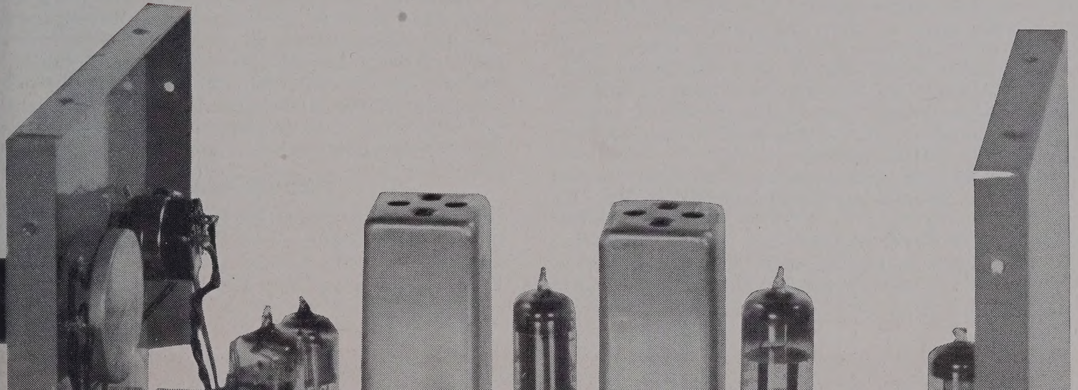


Fig. 1. Side view of the 6-Meter CD Receiver

ntents

6-Meter CD Receiver........pages 1–6
Sweeping the Spectrum........page 7
Technical Information (6BJ6)........page 8

6-METER CD RCVR

This six-meter receiver is a companion unit to the six-meter transmitter described in the January-February 1952 *Ham News*. It is identical in size and shape. The two units together make an ideal transmitter-receiver combination for civil defense use.

The September-October 1951 issue of *Ham News* described a six-meter receiver useful for all purposes. This receiver had excellent sensitivity, and yet was relatively simple, design-wise. Many civil-defense amateurs throughout the country, recognizing the design merit of this receiver, wrote in asking if it could be redesigned specifically for CD use. The 6-meter CD Receiver described in this issue is in answer to these requests.

DESIGN CONSIDERATIONS

The original receiver design, while quite simple, was still too complex for CD use. For example, there were nine front-panel controls or jacks. These included tuning, a.f. gain, r.f. gain, BFO pitch control, BFO on-off control, ANL limiter control, ANL on-off switch, AVC on-off switch and headphone jack. Seating an untrained amateur, or at least an amateur unfamiliar with the controls, in front of such a receiver would be like asking a pilot who has just soloed to fly a B-36 bomber.

In civil defense work almost any amateur may be called upon to operate a given installation. For this reason controls must be kept to a minimum. The 6-Meter CD Receiver uses only three front-panel controls; namely, tuning, gain and ANL control. Despite this, practically none of the original features have been omitted. The BFO on-off switch is available by removing the top cover. In this position it cannot accidentally be turned on, and yet if you wish to use c.w. the BFO may be easily turned on. Similarly, the BFO pitch control is a slug-tuned coil.

The redesign has been carried out in two directions. As just explained, the mechanical layout has been greatly altered to provide a functional receiver. Further, the circuit has been simplified. The original receiver tuned from 50 to 54 megacycles. This required that the r.f. stage track with the oscillator. The tracking problem has been eliminated by designing the CD Receiver so that it covers only a small portion of the six-meter band. Two civil defense segments of the six-meter band, as specified under the new RACES rules, are: 50.35 to 50.75 and 53.35 to 53.75 megacycles. Each segment covers 400 kilocycles, or can be considered to cover twenty 20 kilocycle channels. The 6-meter CD Receiver has been designed to cover 200 kilocycles in either of the two segments. However, note that normally the receiver will be built to operate in only one of these two segments. That is to say, the coils will cover either the high or the low segment, but the receiver must be tuned to just one of the segments. The tuning control will then cover any 200 kilocycle portion of the 400 kilocycle wide segment.

RECEIVER FEATURES

Six tubes are employed in a full superheterodyne circuit. A noise limiter and a BFO are included in the circuit. The output tube will drive a speaker, although headphones may also be used.

Electrical Circuit

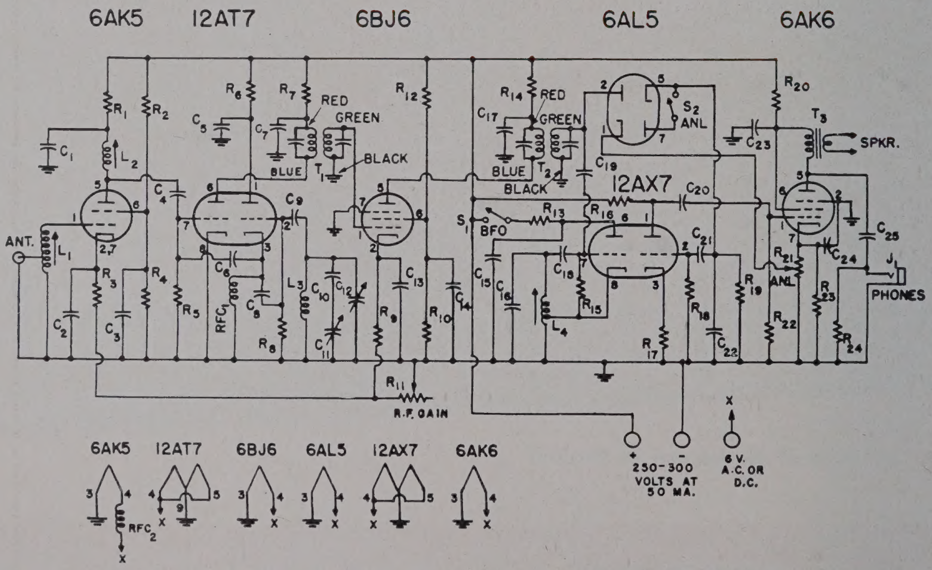


Fig. 2. Circuit Diagram of the 6-Meter CD Receiver

Sensitivity is excellent, and the receiver has a oise figure of approximately 5 to 7 db.

Selectivity is adequate for CD use. Considering venty-kilocycle channels, selectivity is not good nough for adjacent-channel rejection. However, nis situation will rarely be found in CD operation. he actual band width is in the order of plus or minus venty-five kilocycles, to the half-power point.

Current drain is approximately fifty mils, and the oltage required is 250 to 300 volts.

All components specified have adequate safety ctor insofar as voltage and wattage rating is con- erned. For this reason, continuous, day-after-day peration, at 24 hours per day, is easily possible.

CIRCUIT DETAILS

Refer to the circuit diagram, Fig. 2. The 6AK5 ube serves as a broad-band r.f. amplifier. Coils L_1 nd L_2 will resonate in the middle of either the high- equency or the low-frequency segment of the six- eter band, depending on how the slug is adjusted. he 12AT7 tube serves as the local oscillator and e mixer, one section of the tube being used for each nction. Oscillator output voltage is taken from the athode and coupled through C_6 to the grid of the ixer section. The tuning condenser, C_{10}, is placed series with a small capacitance, C_{11}, so that the ning range is restricted to 200 kilocycles. Effectively his series circuit makes C_{11} look as though it has a ery small capacitance.

The mixer feeds a 6BJ6 which acts as the i.f. ampli- er stage. This tube, in turn, feeds a 6AL5 tube hich acts as the sound detector, and also serves as e noise limiter diode. One section of a 12AX7 tube the first audio amplifier stage, while the other sec- on is the beat-frequency oscillator. The output stage is a 6AK6 which is capable of a power output of approximately one watt.

The oscillator is designed to work on the high side of the received signal in order to avoid receiving troublesome images. The only image that can possibly cause trouble, with the oscillator working as shown, is the video signal from a channel 3 television station, but inasmuch as this falls at 51.25 megacycles, and is outside the two CD segments, this is not serious.

The intermediate-frequency chosen for the i.f. stage is 5 megacycles. The reason for this is thoroughly discussed in *Ham News* for September-October 1951. Because no regular i.f. transformers are available for this frequency, they must be home-made. The details of this will be discussed later.

No audio gain control is used in the circuit, as it was not deemed necessary. Audio "loudness" in the speaker or headphones is controlled by the r.f. gain control, R_{11}. Of course, if it seems desirable, an audio gain control can be added. Merely replace R_{22} with a 0.5 megohm potentiometer, connecting the grid of the 6AK6 to the arm of the potentiometer.

The noise limiter is a parallel clipper circuit whose clipping level is adjusted by means of R_{21}. The noise-limiter switch is attached to this potentiometer. Inclusion of a noise-limiter in the receiver circuit is the result of experience. In time of emergency, especially around a radio center, there will be many cars with their motors idling. A noise limiter is a necessity in a CD receiver.

The circuit for this receiver contains everything which is necessary for civil-defense work, and yet contains nothing which is unnecessary. It is strictly a down-to-business communication receiver, designed to do a given job well.

CIRCUIT CONSTANTS

(All resistors and capacitors ±20% tolerance unless specified otherwise)

, C_2, C_3, C_5	270 mmf mica or high-K ceramic
	1000 mmf mica or general purpose ceramic
, C_{10}, C_{19}	2 mmf silver mica (see text)
, C_{13}, C_{15}	0.005 mica, paper or high-K ceramic
	5 mmf mica or general purpose ceramic
	10 mmf mica or general purpose ceramic
1	4–15 mmf variable air condenser (Hammarlund HF-15-X)
2	15–120 mmf mica compression trimmer (El-Menco 302-M)
4, C_{20}, C_{21}	0.001 mica, paper or high-K ceramic
6, C_{22}	100 mmf mica or general purpose ceramic
7	0.01 mica, paper or high-K ceramic
8	50 mmf mica or general purpose ceramic
3	8 mf 450 volt electrolytic
4	50 mf 25 volt electrolytic
5	0.05 mica, paper or high-K ceramic
	Open circuit phone jack
	10 T No. 26 enamel wire close-wound on Millen No. 69042 coil form—tap at 2 T from ground end
	5 T No. 26 enamel wire close-wound on Millen No. 69042 coil form
	4 T No. 14 wire space wound; one-half inch in diameter; self-supporting
	Millen No. 69042 coil form wound full, one layer, with No. 36 enamel wire—tap one-fourth of coil from ground end
	16,500 ohm, 4 watt (two 33,000 ohm, 2 watt in parallel)
R_2	47,000 ohm, 2 watt
R_3	220 ohm, ½ watt
R_4	47,000 ohm, 1 watt
R_5, R_{24}	1.0 megohm, ½ watt
R_6, R_7	4700 ohm, 2 watt
R_8, R_{15}	0.1 megohm, ½ watt
R_9	68 ohm, ½ watt
R_{10}	68,000 ohm, 2 watt
R_{11}	5000 ohm potentiometer 4 watt (Mallory M5MP)
R_{12}	*39,000 ohm, 2 watt (±10%)*
R_{13}	0.1 megohm, 1 watt
R_{14}	15,000 ohm, 2 watt
R_{16}	330,000 ohm, 1 watt
R_{17}	330 ohm, 1 watt
R_{18}, R_{22}	470,000 ohm, ½ watt
R_{19}	220,000 ohm, ½ watt
R_{20}	7500 ohm 4 watt (two 15,000 ohm 2 watt in parallel)
R_{21}	5000 ohm potentiometer (with switch S_2 attached)
R_{23}	*560 ohm, 2 watt (±10%)*
RFC_1, RFC_2	Six-meter r.f. choke (Ohmite Z-50)
S_1	SPST toggle
S_2	SPST (attached to R_{21})
T_1, T_2	465 kc. I-F transformer altered to 5 megacycles as per text
T_3	Output transformer, 10,000 ohms to voice coil (UTC R-38A)

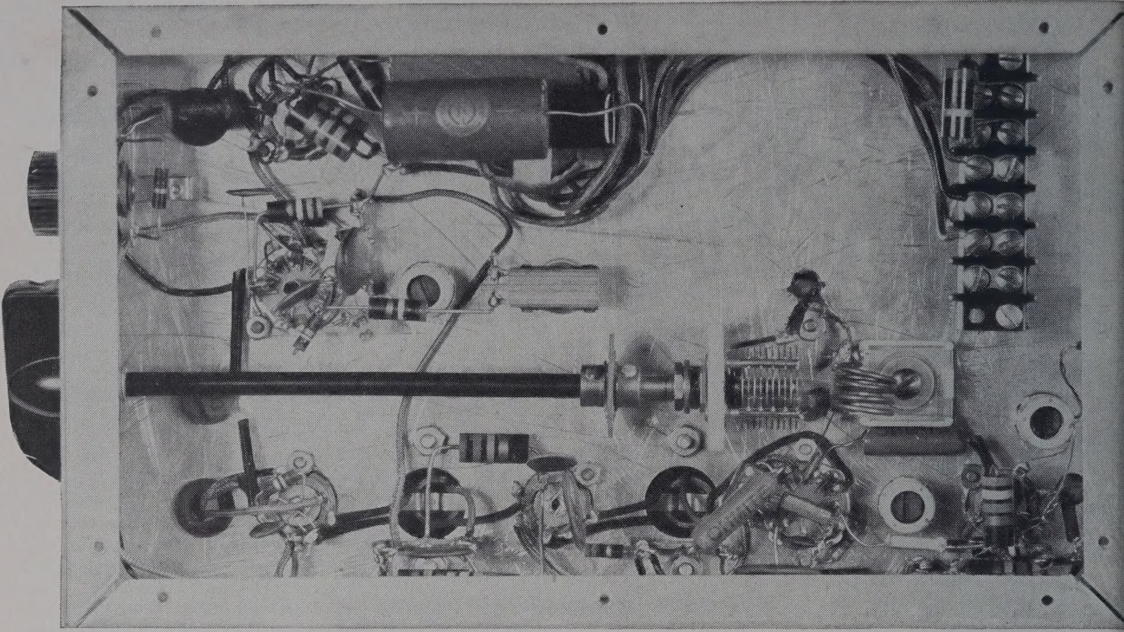


Fig. 3. Underchassis view of the 6-Meter CD Receiver

COMPONENT PARTS

Most of the resistors specified may have a tolerance of 20 percent. A few of them, however, must be ten percent tolerance. These are in *bold-face* type in the Circuit Constants list.

Condensers C_6, C_{10}, and C_{19} are specified as 2 mmf silver mica condensers. Stability is needed and silver mica condensers are recommended. However, if you wish, you may substitute a length of twisted wire in each case, as long as you make sure that the capacitance stays fixed.

The output transformer may be any type which you can find which will match a 10,000 ohm load to a speaker voice coil. This item is not critical in any respect.

CONSTRUCTIONAL DETAILS

The cabinet and chassis are home-made, and are of a size to match the chassis and cabinet employed in building the 6-Meter Transmitter described in the January-February 1952 *Ham News.* Cabinet size and shape is not too important, although you should follow the layout of the parts as closely as possible. There is no substitute for a tried and proven mechanical layout.

Fig. 5 shows the layout of the major parts on the chassis. Hole dimensions are not given in most cases as they will vary depending on type of socket used and type of i.f. transformer used. Front-panel layout is indicated in Fig. 7. No layout is given for the rear panel, as the location of the coaxial connector and the hole for leads is shown clearly in Fig. 1.

Chassis size is ten by six by three inches. Material is 0.030 or 0.040 aluminum. Front and rear panel size is 6 inches wide and seven and a half inches high. Material is 20 gage iron. Bottom plate size is ten by six inches, and the material is 20 gage iron. The top cover piece is in the form of an inverted "U," and of a size that completely covers the box. Material is 22 gage iron. All pieces are held together with sheet-metal (self-tapping) screws.

Inasmuch as five-megacycle I-F transformers of the desired type are virtually unobtainable, it is necessary to purchase 465 kilocycle I-F transforme and convert them. Practically any low-frequency I transformer is suitable which does not have an irc core form. Burned-out transformers would be ide as long as the mica trimmer condensers in them a in good condition. The transformers used in tl receiver are Meissner "Plastic" I-F Transforme The transformers are $1\frac{1}{4}$ inches square and 2 inches high and are rated for the frequency ran from 400 to 550 kilocycles. Three types are ava able: input, output and interstage, any of which c be used because you are going to remove the co anyway. The numbers of these three transform are: 16–6658, 16–6659 and 16–6660.

Regardless of the type of transformer you procu make certain that you do *not* get an iron-core un Further, try to get transformers that have a coil-fo $\frac{3}{8}$ to $\frac{1}{2}$ inch in diameter. The coil-form in the Mei ner transformers just described has a $\frac{3}{8}$ inch diamet It is necessary to enlarge this to $\frac{1}{2}$ inch diamet but this is easily done by winding the form wi paper until it is the right diameter, then putting or final layer of transparent tape. Now, follow the sket of the windings shown in Fig. 8, and wind each c with 40 turns of No. 30 silk or enamel wire. The spaci between coils is $\frac{5}{8}$ inch, as shown, and the wire close-wound. The 40 turns of close-wound No. wire should just take up the $\frac{3}{8}$ inch winding spa shown. For proper connections, follow the col coding shown in the circuit diagram and that sho in Fig. 8. After the coils are wound a small amou of cement may be applied to them to hold the wire place. If the I-F transformers do not tune to 5 meg cycles make any necessary changes only in the tri mer condensers, leaving the coil as specified.

In the under-chassis view, Fig. 3, a terminal st will be seen. This is the main terminal board for t receiver, and is the point to which external voltag are connected. Only five of the six points are use These five terminals are: two speaker terminals, plus, ground, and filament. No switch is provid for the B plus voltage, because most installatio will have a relay or a switch for this purpose on t

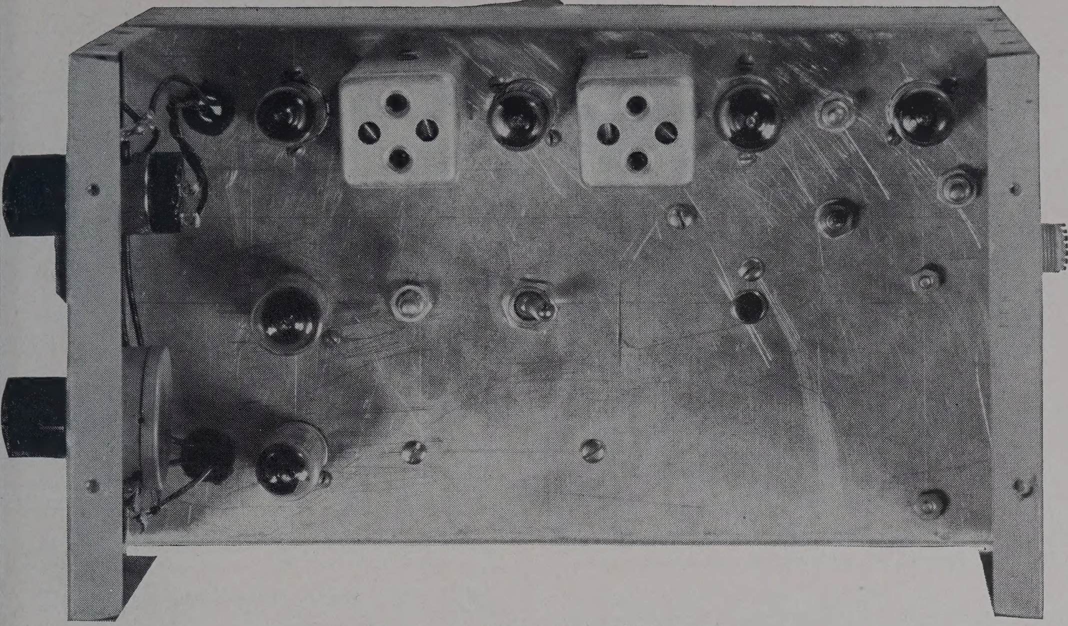


Fig. 4. Top view of 6-Meter CD Receiver

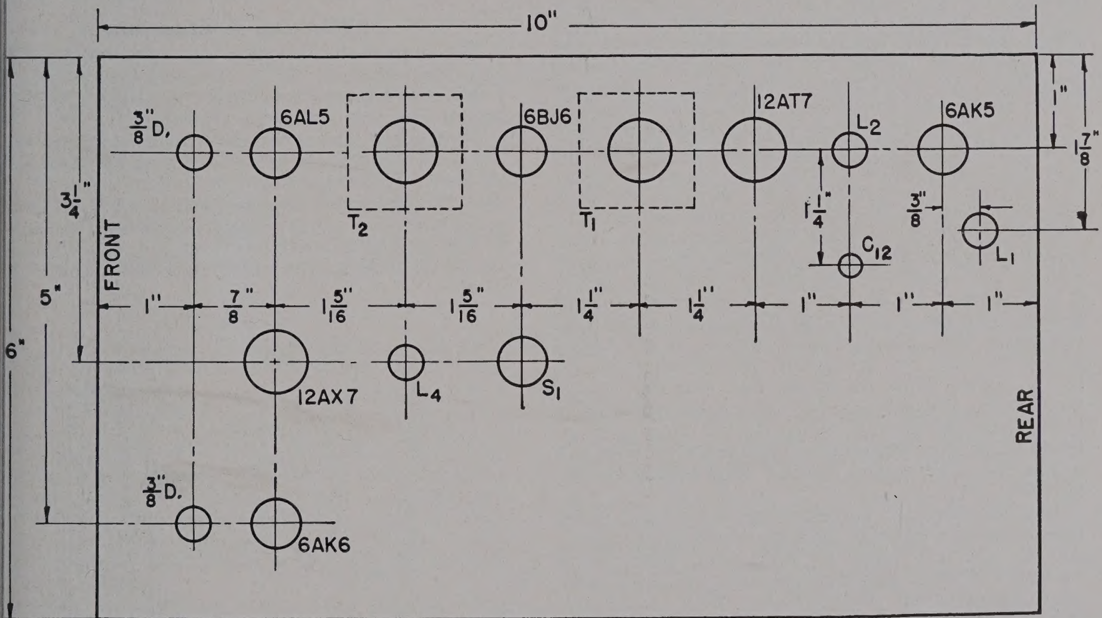


Fig. 5. Chassis layout of 6-Meter CD Receiver

ransmitter itself.

In the same photograph you will see a 2-watt esistor connected across the speaker terminal points n the terminal strip. This resistor is not shown in he circuit diagram. It is a load resistor of approxi- hately ten ohms which is used to provide a load for he secondary of the output transformer. This re- istor must always be in place when headphones are eing used, unless a speaker is being used simultan- ously. The secondary of the transformer must never e unloaded when in use.

TUNE-UP PROCEDURE

If you have a grid-dip meter its use is highly recommended. Set L_1 to either 50.55 or 53.55 megacycles. Do the same with L_2. Next, set C_{11} to half-mesh and tune C_{12} until L_3 is resonant to either 55.55 or 58.55 megacycles.

Next, apply filament and plate voltage, after connecting an antenna and a speaker (or a load resistor across the speaker terminals). Connect an output meter across the speaker terminals, or across the load resistor. Set the grid-dip meter at 50.55 or 53.55

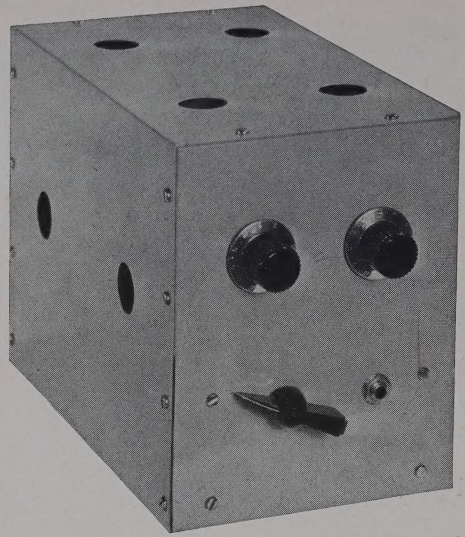


Fig. 6. Front panel view of 6-Meter CD Receiver. ANL control at upper left, gain control at upper right.

megacycles, or use any stable signal at this frequency as a signal source. You may now align the i.f. transformers, adjusting the four trimmers for maximum deflection of the output meter. The r-f. gain control should be set to as low a point as possible to avoid overload. Increase the intensity of the r.f. signal, either by moving the grid-dip meter closer to the receiver, or by advancing the gain on the signal generator, and make certain that the output meter shows an increase in reading. This is a check against overload. If an increase in r.f. signal does not give an increase in meter reading, you are overloading the receiver and you must decrease the r.f. input.

The two I-F transformers will now be operating approximately on the same frequency, so the next step is to set this frequency to 5.0 megacycles. Use a signal generator capable of operation on 5.0 megacycles. You may check its frequency against WWV if you so desire. Connect the output of this signal generator to pin 2 of the 12AT7 through a 100 mmf condenser, and advance the control on the signal generator until you get a suitable deflection on the output meter. Now adjust the four trimmers in the two I-F transformers again, in order to get a maximum reading on the output meter. If the output meter tends to go off-scale, reduce the input by the control on the signal generator. The I-F strip should now be aligned.

Next, remove the I-F signal generator and put a signal into the receiver with an r-f signal generator, and if you are using an adjustable condenser of twisted wire for C_6, adjust this until you get a maximum signal in the output meter. This capacitance can be too low or too high, so search for the optimum point. Finally, retune L_1 and L_2 slightly to achieve maximum reading of the output meter.

The next step is to turn on the BFO and tune the receiver to the frequency of the signal generator, and listen to the beat-note obtained. Adjust C_{19}, assuming you are using a twisted-wire capacitor, until the beat note is the desired strength. If you do not hear a beat, adjust L_4 until a beat appears. Tune L_4 slowly, as the frequency change is quite rapid when tuning this coil. The receiver should now be ready to put on the air.

If you find that the tuning range is not 200 kilocycles, then you must readjust the value of C_{10}. The larger you make C_{10}, the greater the frequency rang and vice versa.

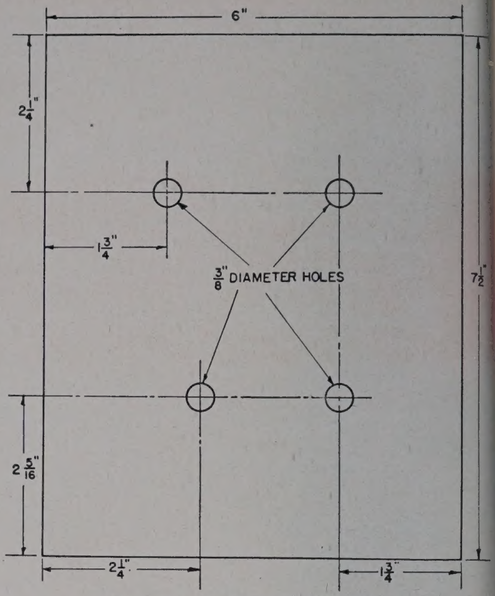


Fig. 7. Front panel layout

OPERATING INFORMATION

Use a good antenna, and one with the proper in pedance—52 ohms. When properly constructed th receiver will have a noise figure of about 6 db, whic means that it is a sensitive receiver.

The noise limiter is the threshold type, whic means it must be adjusted according to the streng of the received signal. If you experience noise, tu R_{21} until the switch operates, and advance the contr until the noise is just equal to the received signa If the control is advanced further, you will clip t signal as well as the noise, and the receiver ma block.

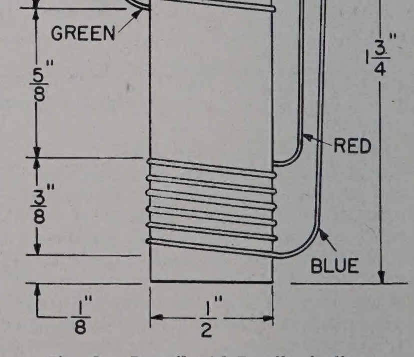


Fig. 8. Detail of I-F coil winding

SWEEPING *the* SPECTRUM

Vith this issue the G-E *Ham News* starts its enth year of publication. Almost two and a half ion copies of this publication have been printed hat time. In the past 36 issues I have tried to er most of the phases of amateur radio. If you that any subject has been slighted, write and tell

'he *Ham News* is available, free, from your nearest ieral Electric Tube Distributor. In the event that find it difficult to obtain in this manner, a subption plan is in effect. For $1.00, the *Ham News* be sent to you for one year. (This offer open only continental USA, Alaska and Hawaii.) Address inquiries and subscriptions to me in Bldg. 267, ieral Electric Co., Schenectady, N. Y.

* * *

)ne of my readers, W9UIM of Sturgeon Bay, sconsin, wrote in to vote on the 6-meter receiver, and he same time mentioned that he suspected that I sn't too interested in the vote, but that I just ited to get some mail. I'm glad my secretary n't see that note! Honestly though, Murray, the thing we need here is more mail. Around the ristmas season I was literally snowed under with il, and I'm just getting out from under that group letters now. Fortunately, the votes that came in n't require an answer, so I was glad to get all of m.

* * *

Another one of my readers, W0JMB of Colorado ings, Colorado, writes in asking how he can posy get his vote in by Feb. 15 when he didn't receive copy of *Ham News* until Feb. 19. I'm glad you ught that up, Jim, because it gives me a chance to lain something. The January-February 1952 issue s due to be shipped to distributors and subscribers January 5. The printing had been complete, and issue was all set to be shipped, when for some xplicable reason the gears didn't mesh in the pping routine and the issue did not get shipped il February 5.

regret the shipping delay. Does the fact that received your March-April issue on time help any?

* * *

'arther down in the mail pouch I find a letter m a California reader. His comments on civil ense work are so interesting that I want to quote m: "Thanks, too, for emphasizing the CD work. ind that Mr. Average Civilian, right here, living l working in an area surrounded with Lockheed, rth American and other plane plants, naval stores, ting fields, key refineries and avion-fuel plants— *still blissfully sleeping*—perfectly confident that *could not* happen here."

I, personally, have been quite pleased at the way the amateurs in many communities have begun to do a first-class job in civil defense communication work. I was also quite overwhelmed at the number of votes I received asking that the 6-meter civilian-defense receiver information be published as soon as possible. Thanks to those of you that took the time to write.

* * *

A recent news release from Electronics Park (the home of General Electric's Electronic Division in Syracuse) tells about the new microwave communication system being installed by G.E. for the Trans-continental Gas Pipeline Corporation. This microwave line extends from Houston, Texas, to Newark, New Jersey. Further, the news release goes on to say that about 15,000 miles of microwave relay systems are currently in operation or under construction for some 20 oil and gas pipeline corporations and other utilities.

G.E. now manufactures and has available two types of microwave equipment. One operates in the 2000 megacycle band and the other in the 960 megacycle band. The reason for telling you this is not to sell you any microwave equipment, but rather to bring to your attention that at least one company (G.E. in this case) is doing a regular business of selling commercial gear to operate at these frequencies. Here is a case where the amateurs are ceasing to be pioneers. A commercial company is selling equipment for use at 2000 megacycles, and yet very few hams have even been on the air in this portion of the spectrum.

The 2300 megacycle amateur band was first used for two-way communication by W2RMA and W2RYT on April 29, 1946. Since that time other experimenters have had equipment in use on that band, but the interest in it seems to be very small. If you, as an amateur, are looking for fields to pioneer in, don't forget the UHF spectrum.

* * *

The tiny two-way wrist radio used in the Dick Tracy comic strip may be nearer to reality than you think. Mr. I. J. Kaar, manager of engineering for Electronic Division said that the development of tiny electronic components known as transistors have brought tiny radios like those used by the comic strip character within the realm of possibility. He said that a really personal radio of hearing aid size running indefinitely on one set of batteries is within sight.

It's nice to know that electronics is making such giant strides. However, I'll bet a new GL-810 against a soldering lug that it will be some few years yet before we can get a kilowatt rig to fit on our wrist.

—*Lighthouse Larry*

Technical Information 6BJ

RADIO-FREQUENCY AMPLIFIER PENTODE

GENERAL DESCRIPTION

Principal Application: The 6BJ6 is a miniature, remote-cutoff pentode designed for use as a high-gain radio-frequency or intermediate-frequency amplifier. Features of the 6BJ6 include low grid-plate capacitance and relatively high transconductance. The low heater current of 150 milliamperes makes the tube particularly suitable in applications where conservation of heater power is important. The electrical characteristics of the 6BJ6 are similar to those of the 6BA6.

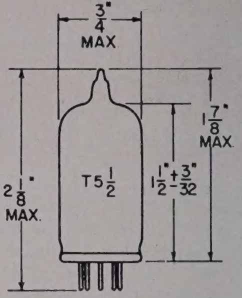
Cathode . . . . Coated Unipotential
Heater Voltage (A-c or D-c) . . . . 6.3 Volts
Heater Current . . . . 0.15 Ampere
Envelope . . . . T-5½ Glass
Base . . . . E7-1, Miniature Button 7-pin
Mounting Position . . . . Any

Direct Interelectrode Capacitances:

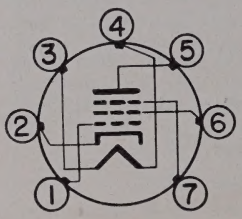
	With Shield*
Grid to Plate (Max)	0.0035
Input	4.5
Output	5.5

* *With external shield No. 316 connected to pins 2 and 7.*

PHYSICAL DIMENSIONS



BASING DIAGRAM



TERMINAL CONNECTION

Pin 1—Grid Number
Pin 2—Cathode
Pin 3—Heater
Pin 4—Heater
Pin 5—Plate
Pin 6—Grid Number (Screen)
Pin 7—Internal Shiel and Gri Number (Suppressor)

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GEO. H. FLOYD, W2RYT—EDITOR

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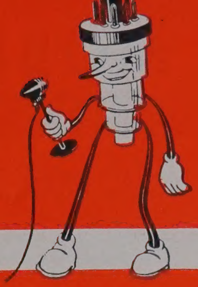


MOBILE-MARINE RECEIVER

Specialized 80 Meter Superhet

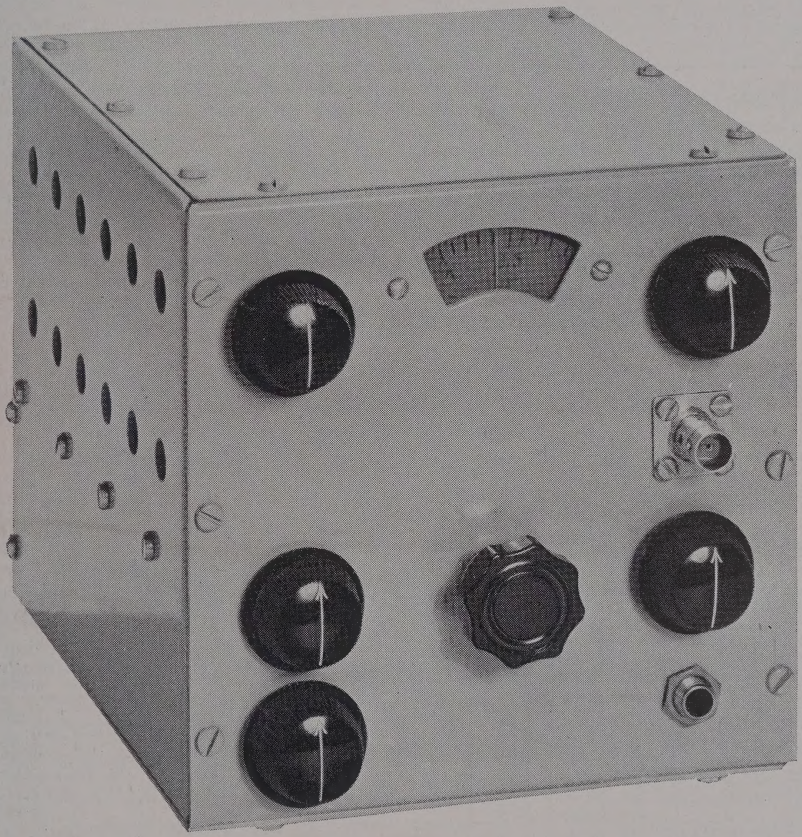


Fig. 1. Front view of the Mobile-Marine Receiver.

ntents

Mobile-Marine Receiver .... pages 1-6, 8
Sweeping the Spectrum .... page 7

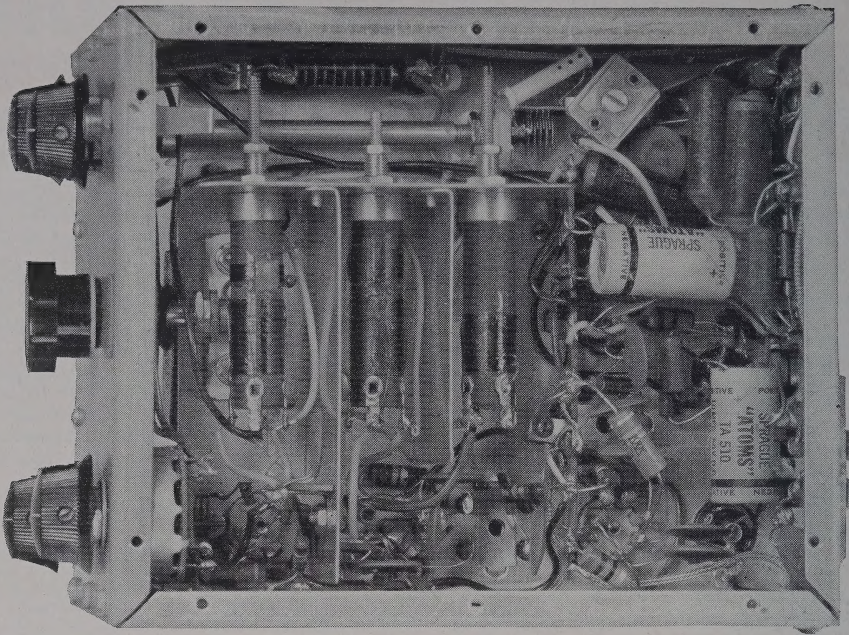


Fig. 3. Underchassis view of the Mobile-Marine Receiver.

As mentioned previously the i.f. transformers should be of the make specified. Other manufacturer's could possibly be used and connected in reverse with the same results but it will require some experimenting.

The coil forms specified are CTC type LS-4, ½ inch diameter with a powdered iron slug. Ceramic coil forms can be substituted if desired, however, they should have a powdered iron slug and not a brass slug, if experimenting for the correct number of turns is to be avoided.

The output transformer, T_4, may be of any type which will match a 5000 ohm load to a speaker voice coil. This item is not critical in any respect.

CONSTRUCTION DETAILS

It is recommended that the mechanical layout shown in the photographs and sketches be followed faithfully. Considerable thought was given to the mechanical design and layout since compactness is the keynote in any mobile equipment. Note that the various stages are placed in an orderly straight-line manner to allow the wiring to be short and direct as possible. The cabinet was fabricated from 1/16 inch thick aluminum sheet and arranged so that it may be completely disassembled. All components are mounted on the chassis and panel. When the sides, top and bottom are removed, the components and wiring are all easily accessible without probing into corners or small compartments.

The only shield partitions and brackets required are those around the coils and the padder condenser bracket. An inspection of Fig. 3 and Fig. 4 will disclose the details. Dimensions are not given for these parts, however, no difficulty should be encountered as the actual sizes are not critical.

The first step in constructing the receiver is to make the complete cabinet. It is recommended that the parts be made in the following order:

1 - chassis
2 - sides
3 - top
4 - bottom plate
5 - shield partitions and brackets

All parts are made of 1/16 inch thick soft aluminu
except the top, shield partitions, and brackets whic
are made of 1/32 inch thick aluminum. By usi
this material it is practical to make the bends in
vise by using two pieces of wood between the ja
and both sides of the work and just long enough
equal the length of the bend. The easiest procedu
is to make the bends by using a third piece of wo
held in both hands in back of the aluminum a
carefully pulling the work forward and down at t
same time. This will result in a smooth even ben
Of course, if a sheet metal brake is available the j
will be easier. This tool is by no means essential f
working small pieces of soft aluminum.

In constructing the chassis, make the lip ben
first by clamping the lip portion in the vise and usi
the larger area for leverage. The rear of the chass
should be bent down last. Figure 5 gives the dime
sions of the chassis excluding the bend and the li
Figure 6 gives the dimensions of the rear bend a
the lips.

Using the chassis as a guide for dimensions, t
sides and panel can then be made. It is advisable
make these partly from actual measurements fro
the preceding parts in the order stated above rath
than from the drawings as it is difficult to hold exa
dimensions when making the bends. A good workma
like job will result if the parts of the cabinet are ha
fitted to each other. The cabinet is held together
means of No. 6 x ¼ inch binding head, self tappi
sheet metal screws.

In order to make the padding condenser brack
and shield partitions more rigid, small gussets a
formed at the various bends. These gussets a
made by placing the bent part over a piece of s
wood and then placing a 1/8 inch diameter steel r
at an angle of 45 degrees on the outside of the be
and striking it with a hammer. This will push t
aluminum under the rod into the soft wood a
result in a surprising increase in strength.

The particular three gang tuning condenser us
came equipped with a dial cord drum and no sh
extension. Therefore, a dial cord drive was devis
and a home made translucent dial was installed

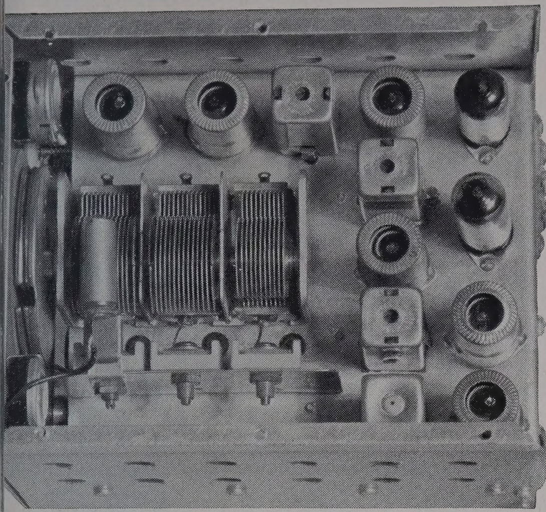
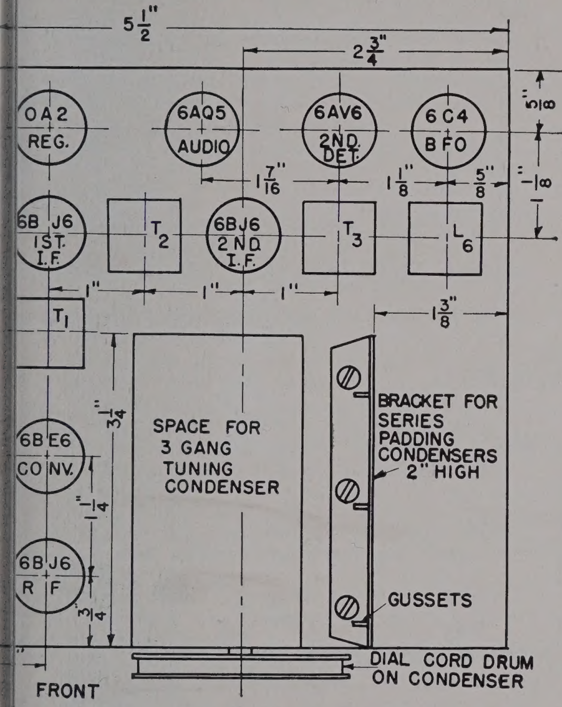


Fig. 4. Top view of the Mobile-Marine Receiver.



ig. 5. Chassis layout of the Mobile-Marine Receiver.

ow for calibration marks. The dial drive was made supporting a ¼ inch diameter shaft in a panel shing held by a bracket to the underside of the assis. This is lined up with the hole in the front nel. The vernier action is improved if the portion the shaft around which the dial cord rides is turned wn to about 1/8 inch diameter. This may be easily ne by turning the shaft in an electric drill and lding a rat-tail file against it. The dial plate itself a piece of 1/8 inch thick lucite with the surface osted by rubbing with fine emery paper and water. e calibration marks can then be drawn on. It is commended that this be done with pencil so the libration can be changed easily if it is ever desired to change the frequency range. The dial plate is bolted to the drum with small machine screws and bushings.

The beat frequency oscillator condenser, C_{36}, is fastened to the chassis with an angle bracket so that it lines up with the panel hole. A bushing is used in the panel to provide a smooth bearing surface. No commercial beat frequency oscillator transformer of small enough size was available so it was necessary to fabricate one. A National type R-300U, 1 mh r.f. choke was used as the coil. This choke has three pies. The cathode tap is made at the end of the first pie above the ground end of the coil. A ¾ inch square by 2 inches high shield can was obtained from an old TV i.f. transformer and the choke was mounted inside. It is necessary to melt the top metal end off of the choke coil with a soldering iron and unwind a few turns so that connections can be made at the bottom of the can. The threaded stud of the r.f. choke is bolted through the original bottom support of the i.f. transformer and the whole assembly is then mounted on the chassis in the normal manner. The beat frequency oscillator output is coupled to the second detector by means of capacitor Cx which is a three-inch piece of wire twisted around the lead indicated in the circuit diagram. The coupling is not critical but should be adjusted for good c-w reception.

The location of the r.f. coils can be determined by an inspection of Fig. 3. They should be centered midway between the chassis and the bottom plate.

The only subassembly required is the terminal board containing the second detector and noise limiter components. This is shown in Fig. 9. This unit can be made from a 1/16 inch thick piece of bakelite or similar material. The terminals can either be No. 2 machine screws or some of the commercially available tiepoints. This subassembly should be wired up outside the receiver. Fairly long leads should be left so that connection to the points indicated can be made later.

The power and output transformer terminals are located on the rear of the chassis. They are visible in Fig. 3. The output transformer itself is not part of the receiver but rather a part of the loudspeaker.

WIRING DETAILS

In wiring the receiver it was found advisable to make up a temporary front panel out of scrap aluminum and fasten it to the chassis with brackets. This allows the controls to be wired in their proper position. After the wiring is complete and the receiver aligned the temporary panel can be discarded and the complete cabinet assembled.

The filament circuits should be wired first. Next, the stages should be wired starting with the audio output and beat frequency oscillator and working toward the front end of the receiver. The second detector sub assembly is mounted last against the back side of the chassis and wired in.

Tests were made after the receiver was complete to see whether lead dress would affect stability. No sensitive wires could be found so it is safe to assume that ordinary good wiring practice is all that is necessary to assure satisfactory results.

ALIGNMENT

After the wiring has been completed and rechecked it is necessary to align the various stages. The i.f. stages should be aligned first in the following manner. With proper voltages applied, the receiver should be allowed to warm up for a few minutes. A signal generator set at 455 kc should be connected through a small fixed condenser to pin number 5 of the second i.f. tube and the slug of T3 adjusted for maximum output as indicated by headphones,

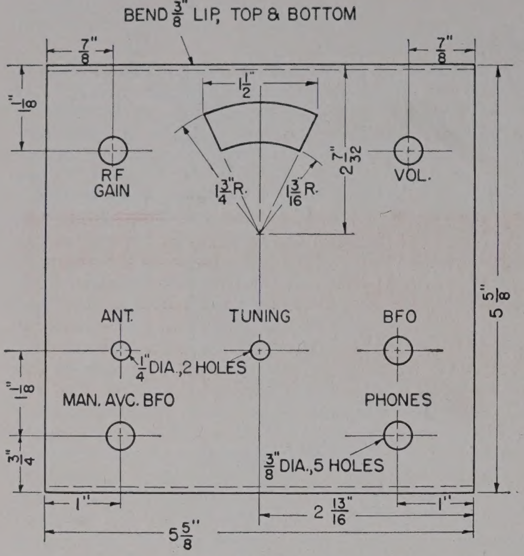

BEND 3/8" LIP, TOP & BOTTOM
7/8"
7/8"
1 1/8"
1 1/2"
2 7/32"
RF GAIN
1 3/4" R.
1 3/16" R.
VOL.
5 5/8"
ANT.
TUNING
BFO
1/4" DIA., 2 HOLES
1 1/8"
MAN. AVC. BFO
PHONES
3/4"
3/8" DIA., 5 HOLES
1"
2 13/16"
1"
5 5/8"

Fig. 7. Front panel layout of Mobile-Marine Receiver.

loudspeaker or an output meter. Next, the signal generator is connected to pin 5 of the first i.f. tube and the slug of T_2 adjusted for maximum output. The signal generator should then be connected to pin 5 of the mixer tube and the slug of T1 adjusted for maximum output. This procedure should be repeated several times to be sure that each stage is peaked to the exact frequency. After this has been completed the r.f. section should be aligned on the high end of the tuning range. The main tuning condenser, C_2, is set at minimum capacity and condensers C_9 and C_{12} set at maximum capacity and C_2 set at mid-position. With the signal generator set at 4.1 megacycles and connected to pin 1 of the

(Continued on page 8)

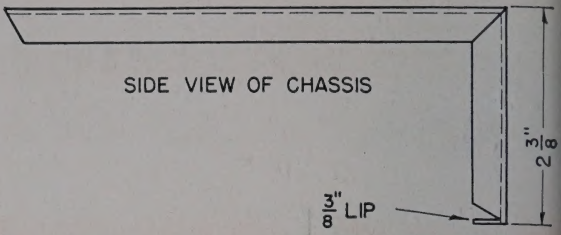
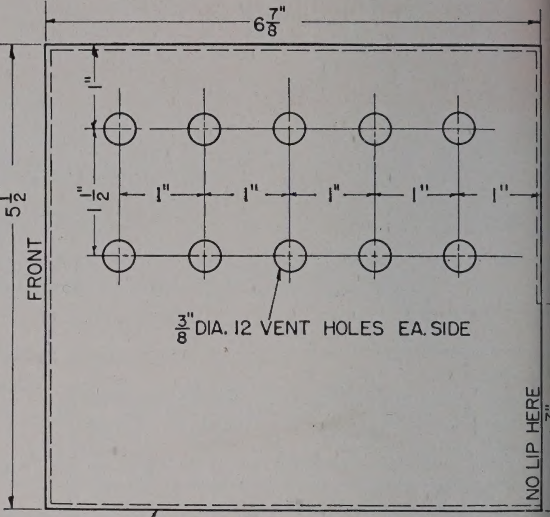

SIDE VIEW OF CHASSIS
2 3/8"
3/8" LIP

Fig. 6. Side View of chassis showing bends and lips.


6 7/8"
5 1/2"
FRONT
1"
1 1/2"
1"
1"
1"
1"
1"
3/8" DIA. 12 VENT HOLES EA. SIDE
NO LIP HERE

BEND 3/8 LIP EXCEPT WHERE NOTED
SIDE - MAKE 2, BEND LIPS CORRECTLY FOR RIGHT AND LEFT SIDES

Fig. 8. Side panel layout for Mobile-Marine Receiver.

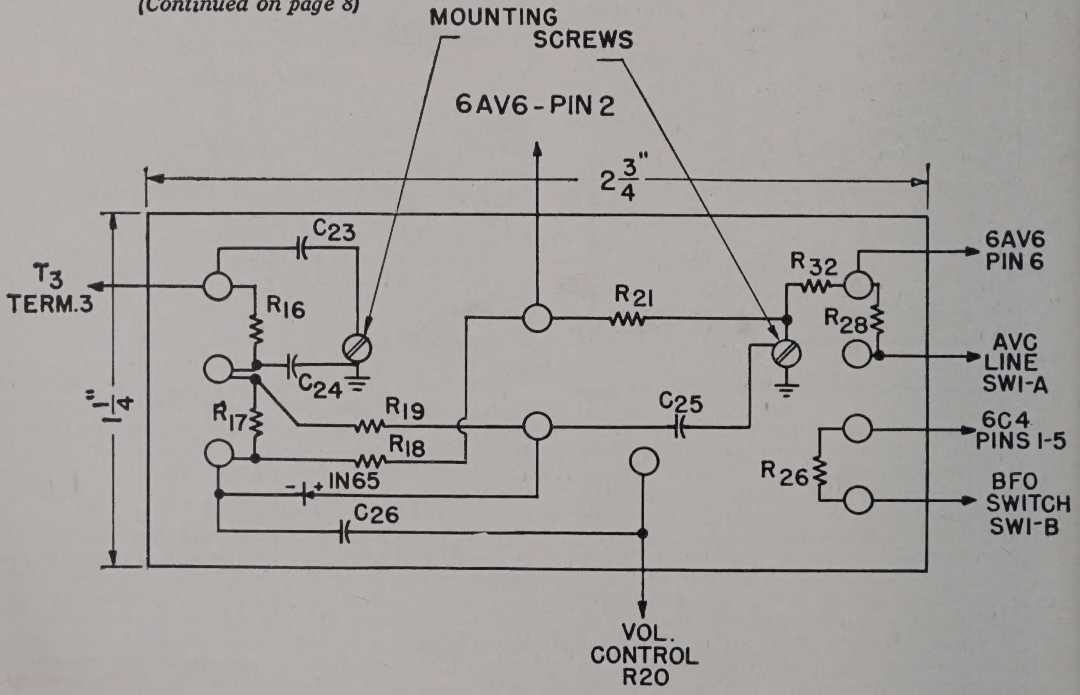

MOUNTING SCREWS
6AV6 - PIN 2
2 3/4"
T3 TERM.3
C23
R16
C24
R17
R19
R18
IN65
C26
R21
C25
R32
R28
R26
1 1/4"
6AV6 PIN 6
AVC LINE SWI-A
6C4 PINS 1-5
BFO SWITCH SWI-B
VOL. CONTROL R20

Fig. 9. Sub-assembly diagram.

SWEEPING *the* SPECTRUM

n the last issue, it was reported the G-E *Ham* *ws* was starting its seventh year of publication. wever, it was also George H. Floyd's (W2RYT) issue as Editor of this publication. George has us to accept another position within the Comy. I believe I can speak for all of you readers to h George the best of luck with his new adventure l congratulate him for the bang-up job he has ie with G-E *Ham News.* If you fellows hear RYT on the band at anytime give him a call as will be glad to have a QSO with you.

While we are saying our farewells to George we not help but reminisce somewhat of the beginning this publication. It started back in the early part 1946 when W2DC, Manager of Sales, Industrial Transmitting Tube Department, was puzzling r the problem of how to reach more of the engirs, technicians, and repairmen in regard to G-E tronic tubes. It occurred to W2DC, that most these fellows were also Amateurs, therefore, why put out a publication for them. So with this in id, George was given the assignment of origiing and producing such a publication. Needless say, he worked many hours in formulating and nning what to put out that would be different m other Amateur publications. The results were E *Ham News* and yours truly. (Incidentally, Lightise Larry is the modest little genius who answers questions. You will find his picture at the top of s column. He was conceived by inverting a Lightise Tube and adding arms, legs, and facial exssion. While his true name is Lighthouse Larry has received some letters calling him other names, h as Lamp Post Larry, Lighthouse Harry, Lightst Harry, Hothouse Harry, and others which can be printed. However he is addressed, he is always ppy to hear from you fellows. Editor's note)

Perhaps some of you would like to know our policy equipment described in G-E *Ham News* and who on the unofficial staff. First of all the policy is y simple as you can see:

1—The equipment described must be of the type ich the average Amateur can build and be reasonly assured of duplicating our results.

2—The equipment must not require a complete chine shop to construct it, but tools the average low has.

3—No complicated or trick circuits requiring oratory equipment for proper alignment or test l be used.

4—Only standard components available from local parts distributor will be specified, unless, the designer feels it is absolutely necessary to use nonstandard components to achieve maximum results.

5—The technical theory and design must be sound and practical.

6—All equipment must be tried and proven and undergo considerable test before it can appear in G-E *Ham News.*

Believe it or not fellows, as simple as this policy is it is sometimes difficult to meet. We have designed equipment which has not appeared in G-E *Ham News* because it was either too difficult to build or required laboratory equipment to test.

The unofficial staff, as we like to call it, consists of Amateurs who contribute part of their time and efforts. As you probably suspect, they are research associates and engineers of General Electric. Here are their call letters and names:

W2CCP	K. A. Bardin
W2FZW	S. G. (Ty) Reque
W2GYV	L. F. Jeffrey
W2KUJ	D. E. Norgaard
W2NOY	C. W. Bleichner
W2RKL	R. L. Watters
W2RMA	A. R. Koch
W2RYT	G. H. Floyd
W2UKL	A. H. Sharbaugh
W2WPV	R. L. Voeller
W2ZHI	W. N. Coffey
W4PFQ	A. P. Haase

⁂ ⁂ ⁂

While we are on the subject of G-E *Ham News* this seems like the proper time to answer those many requests as to how it may be obtained. This publication is available, free, from your nearest General Electric Tube Distributor. For those of you who find it difficult to obtain in this manner, a subscription plan is in effect. For $1.00, G-E *Ham News* will be sent to you for one year. (This offer open only in continental USA, Alaska and Hawaii.) Address all inquiries and subscriptions to me, Bldg. 267, Tube Department, General Electric Co., Schenectady, N. Y.

—Lighthouse Larry

MOBILE MARINE RECEIVER

ALIGNMENT *(Continued from page 6)*

mixer tube, the slug in L_5 should be adjusted until a signal is heard. The signal generator is then connected to the antenna terminals and the slugs in L_1, L_2 and L_3, L_4 adjusted for maximum output. This procedure should be repeated several times to overcome any interaction between stages. After this has been completed, the low end of the band should be aligned. The main tuning condenser, C_2, is set at maximum capacity. With the signal generator set at the low frequency desired (in the original receiver this was 2 megacycles) and connected to pin 1 of the mixer tube, adjust C_{11} until the signal is heard. The signal generator is then connected to the antenna terminals and the series padder condensers C_1 and C_8 adjusted for maximum output.

The complete high and low frequency alignment procedure should be repeated several times to make sure that each successive adjustment has not detuned the preceding one.

After the above procedure has been completed, tracking over the entire range should be checked. It may be necessary to adjust the parallel padders C_9 and C_{12} for proper tracking, however, in the original receiver these were set at maximum capacity and left alone. Fine tracking can be obtained by bending the plates of the tuning condenser, but again this was not found necessary.

If the tuning range is going to be restricted to the 80-meter band only, capacitors C_1 and C_8 shoul
be changed to 4-50 uufd (ICA type 611 padders
and capacitor C_{11} changed to 12-120 uufd (IC
type 612 padder). This will bring the maximu
capacity of the tuning combination down to a lo
enough value to spread the 80 meter band over th
whole dial.

OPERATING INFORMATION

The operation of this receiver is all that coul
be desired. On-the-air listening tests have brough
in all but the sixth and seventh districts using a si
foot clip lead antenna on the cellar work bench a
W2GYV. Even though the 80-meter band is crowde
at the high end of the band, no difficulty was foun
in separating stations. The i.f. response was foun
to be approximately 7 kc wide at the half-powe
point and the curve had rather steep slopes indicatin
good adjacent channel selectivity.

The stability of the receiver is good enough t
allow continuous monitoring of the Marine telephone stations for hours without retuning. Mechanically, it is sturdy enough to survive a sharp blo
of the hand without shifting the tuning.

To those of you who build this receiver, be sur
to use good quality parts and careful workmanshi
so that you can enjoy many happy hours of mobil
operation.

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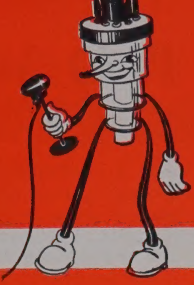

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EPTEMBER-OCTOBER, 1952

VOL. 7—NO. 5

POWER PEAKER

a 200-watt output linear amplifier for single sideband.

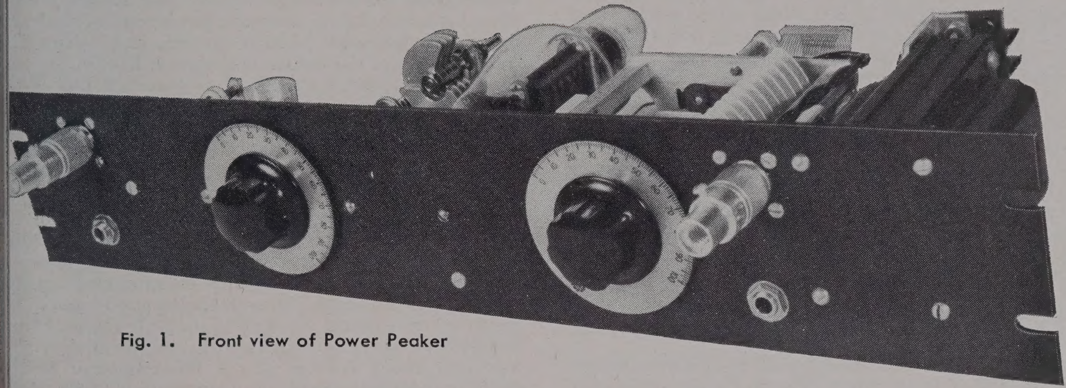

Fig. 1. Front view of Power Peaker

The Power Peaker is a complete single-tube linear amplifier featuring compact design for relay rack mounting. The r.f. driving power, for full 200-watt peak output, is less than 5 watts on any band from 80 meters to 10 meters. Thus, use of the Power Peaker driven by a single-sideband exciter, such as the SSB, JR (G-E HAM NEWS, VOL. 5 NO. 6), allows the single-sideband enthusiast to increase power by approximately 20 db. Two hundred watts of single-sideband is more than the communication equivalent of a half-kilowatt (plate input), high-level modulated AM rig operating at 80% efficiency. The Power Peaker will serve as an effective link between the 5-watt exciter and the antenna or a super-power (about 5 KW) final.

GENERAL DESCRIPTION

The Power Peaker amplifier is entirely self-contained (except for plate power supply) on a 3½ x 19 inch relay rack panel. All parts mount directly from the panel so that construction is easy and straightforward. The power amplifier tube is the rugged and dependable GL-811-A mounted horizontally near the center of the panel. Coaxial fittings are used for the r.f. input and output connections. Input and output tuning controls are accessible on the front panel as well as grid and cathode current jacks for circuit metering and tune-up. A filament transformer (T1) is mounted on the back of the panel to simplify the metering circuits and to avoid voltage drop in long filament leads.

Easily accessible plug-in coils are used for grid and plate circuits. Coupling adjustments may be made readily to match both input and output. These adjustments, once made for each band, "go with the coils" and need not be done again when changing bands. The neutralizing adjustment remains fixed from one band to another.

CIRCUIT DESIGN DETAILS

The circuit diagram of a linear amplifier is almost the same as that of a class "C" amplifier. Close inspection, however, will reveal an important difference between the Power Peaker and the conventional class "C" amplifier, that of bias. The GL-811-A is operated at zero bias and this feature makes additional swamping unnecessary. Actually this linear amplifier is self-swamped. Operating at zero bias reduces the driving power required, stabilizes the input impedance to reduce amplifier distortion, and, of course, eliminates the need for a bias supply.

The grid circuit is used as a phase inverter (accomplished with a split-stator tuning condenser) to per-

ntents

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mit grid-circuit neutralization. This arrangement reduces complexity and cost in the output circuit since it allows a single-unit plate tuning condenser to be used. The center tap of the grid coil is brought out to a grid-current jack (closed circuit type) through a 2.5 millihenry r.f. choke. The operating Q of the grid circuit is approximately 25.

The plate circuit is shunt-fed, thus reducing the insulation requirements on both the output tank coil and tuning condenser. Shock hazard is also reduced by this method. Economy of the design of the Power Peaker is exemplified by the use of small exciter-size plate tank coils. Although the amplifier will deliver a peak power output of 200 watts when loaded and driven properly, the small-size coils do not overheat. This, of course, is true because the average power of speech is small compared to peak power. The operating Q of the plate tank circuit is approximately 12 when the amplifier is loaded properly.

The over-all electrical design of the Power Peaker is aimed at economy, high efficiency (70% on peaks) and low distortion. Complete fulfillment of these design aims will not obtain, unless the coils and tuning condensers have respective inductances and capacities that are compatible with the original design. Because of the wide tuning range available, it is not sufficient just to use coils that will resonate at the desired frequency—they must resonate with the correct capacity for the frequency band in use.

It is strongly recommended that the Power Peaker be used ONLY with single-sideband suppressed carrier signals. The rating given is for this mode of operation only. More than momentary testing with continuous signals is almost certain to damage several of the components due to overheating. Keep this in mind.

CONSTRUCTIONAL DETAILS

The Power Peaker linear amplifier uses standard components throughout except for modification of the coils. This is necessary to obtain the required L/C ratios. Fig. 4 gives the layout of the 3½ x 19 inch (steel or aluminum) panel. Remember to reserve a clear space of at least one inch at each end of the panel for mounting on the rack. The plate tank condenser, C7, is spaced ½ inch from the panel by the three spacers furnished with the Hammarlund TC-220K condenser. Before mounting this component, scrape the paint from the rear of the panel under the spacers to assure good electrical connection. The socket for the plate tank coil, L4, is mounted on the end of the plate condenser, C7, with ¾-inch spacers, and oriented so that the axis of the coil is as shown in Fig. 3. The coil socket pins 1 and 6 should be toward the top of the panel. Ground pin 6 and use pin 1 for the adjustable tap connection. It will be necessary to drill and tap the back of the plate tank condenser in order to mount the coil socket. Be certain to use fiber washers next to the ceramic socket to prevent cracking as it is tightened.

The grid tuning condenser, C1, is mounted on the rear of the front panel after the paint is removed from the area immediately around the mounting hole. In general, be certain to do this for all grounded components. The National STN neutralizing condenser, C2, is mounted on a metal bracket ½ inch by 1⅝ inch long fastened to the rear of the grid tuning condenser, C1. The rear shaft bracket of the Hammarlund MCD-100M condenser already has two tapped holes (No. 4–40 thread) which can be used to mount the bracket. The stator plate of the STN condenser must be insulated from this bracket by means of the two stand-off insulators supplied with the condenser.

Electrical Circuit

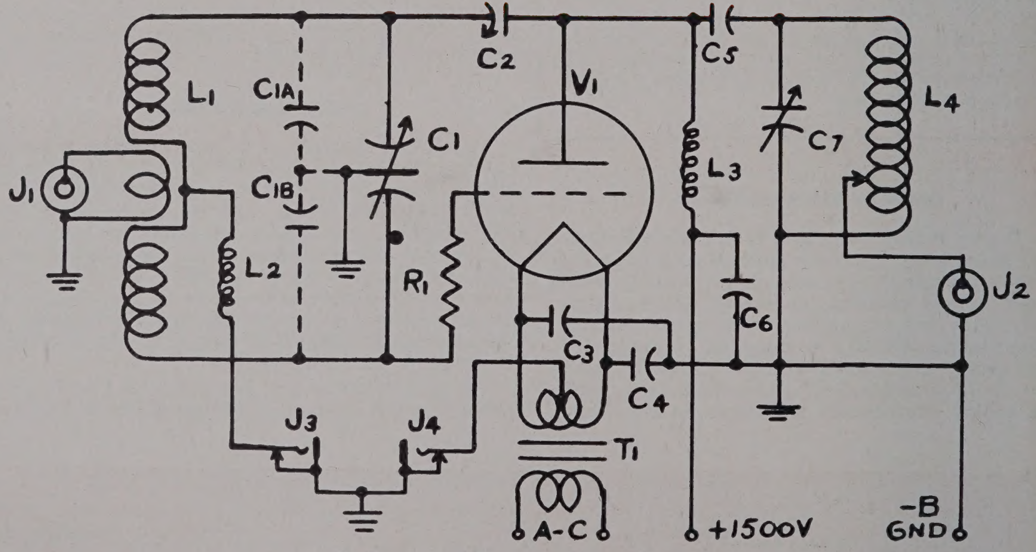

Fig. 2. Circuit diagram of Power Peaker

utput linear amplifier for single sideband

The tube socket should be spaced from the panel by vo ¾-inch metal or ceramic spacers. The plane of ns 1 and 4 (filament pins) must be vertical as the nel is to be mounted. This is necessary to protect e tube from damage due to filament sag. The two 01 mfd ceramic disc filament by-pass condensers e mounted between the socket and the panel using ortest possible connections to a lug securely ounded. The plate supply by-pass condenser, C6, ands alongside the socket and one end is grounded to lug fastened under the other socket spacer. The B us end of the condenser is soldered to a lug mounted a ceramic stand-off insulator. This point also serves support the cold end of the National R-100, 2.5 illihenry shunt-feed r.f. choke. The plate blocking ndenser, C5, is mounted between the stator lug of e plate tank condenser, C7, and the hot end of the unt-feed choke, L3. A solid wire connects from this st-named point to the stator of the **STN** neutralizing ndenser, C2. The objective here is to provide a rigid ounting for the blocking condenser, C5, and the top the plate choke, L3, and to provide a connection int for the short insulated stranded-wire plate lead. e top of the blocking condenser, C5, should be be- w (toward the panel) the plane of the bottom of the ate of the tube to prevent interception of large nounts of heat radiated from the tube. A straight- ross mounting of the blocking condenser should be out right, with due allowance made for inserting the L-811-A. Fig. 3 shows these details clearly. A solid re connection should be made from the same lug at mounts one end of the blocking condenser to the t pin of the plate coil socket mounted on the end- ate of the tuning condenser. Use No. 14 AWG (or rger) for these solid-wire leads.

The filament transformer, T1, is mounted ½ inch om the panel on metal spacers to clear the leads hich come out the bottom of the transformer. If the ansformer you use does not have the leads coming it this way, it may be mounted flat against the panel. terminal board is fastened to the top of the trans- rmer by means of two right-angle metal brackets. This terminal board serves to connect the a-c supply and the 1500-volt d-c plate supply to the amplifier. A barrier-type terminal board is recommended for the sake of safety and to prevent inadvertent short circuits.

The center tap of the 6.3-volt winding of transformer T1 should be connected to the tip spring terminal of the closed-circuit cathode current jack, J4. Be certain to ground this jack securely to the metal panel. There is space on the panel below the transformer for a primary filament switch, if separate control of the filament is desired.

The ceramic socket, for the grid coil L1, is mounted on stand-off insulators so that the axis of the coil is vertical as shown in Fig. 3. The socket pins used for the swinging link should be toward the end of the panel for convenience in wiring and adjustment of the swinging link. The end connections (pins 2 and 5) of the grid tank coil should be connected with solid wire to the two stator sections of C1. The stator section away from the panel should be connected to the rotor of the **STN** neutralizing condenser. The stator section nearest the panel should connect to the grid pin of the GL-811-A socket (pin 3) through a 10-ohm, 1-watt non-inductive resistor (R1). This resistor is mounted by its pigtail leads between the stator connection and the socket terminal. The center tap of the grid coil (socket pin 4) should connect through a National R-100, 2.5 millihenry r.f. choke, (L2), to the tip connection of the closed-circuit grid current meter jack, J3. This choke may be supported by its pigtail leads from the socket connection and the jack terminal. Ground pin 3 of the grid coil socket to the panel with as short a lead as possible.

The filament wires may be twisted together and run between the plate condenser and the panel from the transformer to pins 1 and 4 of the GL-811-A socket. The B plus lead should run from the terminal board to the ceramic post supporting the shunt-feed r.f. choke. This lead should be kept clear of the stator connection of the plate tank condenser. Be certain to use wire with adequate insulation to withstand the 1500 volts.

CIRCUIT CONSTANTS

(All resistors and capacitors ±20% unless specified otherwise)

1	*100-100 mmf variable condenser, Hammarlund MCD 100-M*
$_A$, C1$_B$	*See coil table*
2	*3-18 mmf neutralizing condenser, National STN*
, C4	*0.01 mfd disk type ceramic condensers*
, C6	*0.001 mfd, 2500 volt mica condenser*
7	*220 mmf variable condenser, Hammarlund TC-220K*
L1, L4	*National AR-17 coil, modified. See coil table*
L2, L3	*2.5 mh r.f. choke, National R-100*
R1	*10 ohm carbon, 1 watt resistor*
T1	*6.3 volt, 4 amp., ct, Stancor P4019 or equivalent*
J1, J2	*coax jack*
J3, J4	*Closed circuit phone jack*
V1	*GL-811-A tube*

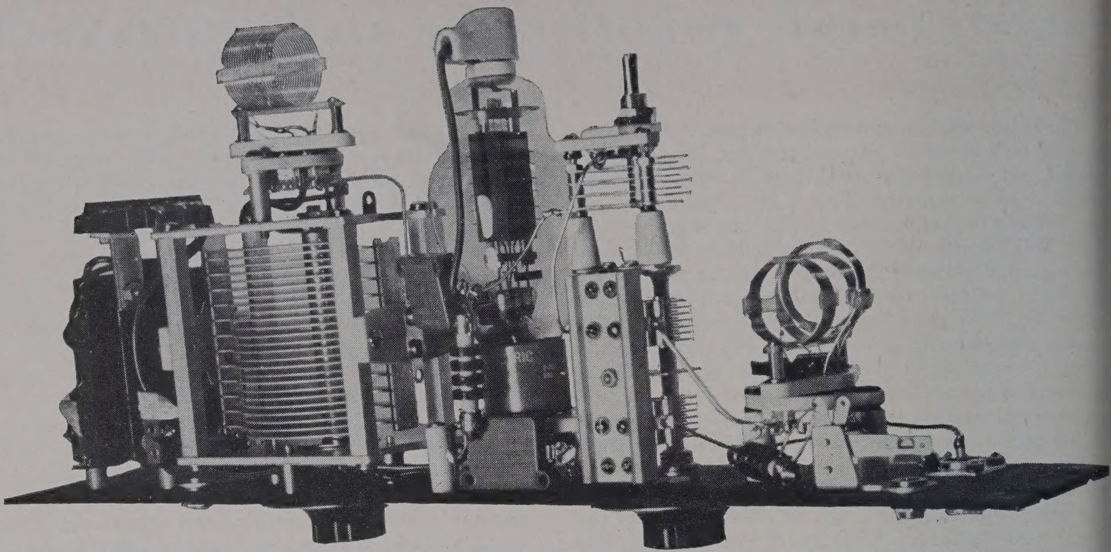

Fig. 3. Bottom view of Power Peaker

COIL DATA

It is essential to use coils having the correct inductance in order to meet the operating circuit Q's. The coils selected require modification in most cases in order to reach the required values. In addition, the two low-frequency-band grid coils require padding condensers mounted on the coil base as shown in Fig. 5.

Band	Coil	L μhy	Description
3.5–4.0	**L4**	**10**	National AR17-40E. Remove end link. Remove 8 turns. Provide 10 taps at ½ turn intervals from Pin No. 2 end. Connect Pin No. 6 to Pin No. 2 across top of coil base. Use a lead connected to Pin No. 1 for connection to taps.
	L1	**14.5**	National AR17-40S. Remove center tap of swinging link. Connect 150 mmf MICA condenser from each end of coil to Pin No. 3 of coil base. See Figs. 2 and 5.
7.0–7.3	**L4**	**4.6**	National AR17-20E. Remove end link. Tap each ¼ turn for 3 turns and make other connections as described for 3.5–4.0 MC plate coil.
	L1	**7**	National AR17-40S. Remove 3 turns from outer ends of each coil half. Remove center tap of swinging link from Pin No. 3 and connect a 50 mmf MICA condenser from each end of coil to Pin No. 3 of coil base. See Figs. 2 and 5.
14–14.4	**L4**	**2.7**	National AR17-20E. Remove end link. Remove 4 turns. Tap coil every ¼ turn for 3 turns and make other connections as described above for plate coils.
	L1	**2.5**	National AR17-20S—Remove CT from link.
21, 27–30	**L4**	**0.9**	National AR17-10E. Remove end link. Remove 2 turns. Tap each ⅛ turn for 2 turns and make other connections as described for plate coils.
	L1	**1.2**	National AR17-10S. Remove CT from link.

The inductance values for each coil are given for those who wish to make their own coils.

It might be necessary to remove some of the turns in the swinging links of the grid coils to facilitate matching the exciter into the Power Peaker. Do this if the exciter does not load properly when the link coil is fully meshed with the grid-tank coil.

POWER SUPPLY CONSIDERATIONS

A special word is in order concerning the plate power supply used with the Power Peaker linear amplifier. The L/C ratio chosen for the plate tank circuit is based on the use of a power-supply voltage of 1500 volts. Use of materially lower voltage (such as 1200 volts) will result in a loaded Q that is too low for proper operation of the amplifier when it is loaded as described under the section entitled MATCHING AND LOADING. A serious consequence of low output circuit Q is an abnormally high harmonic output. Thus, to develop rated output power while providing suitable load conditions for the amplifier tube, the power supply should deliver 1500 volts under load.

Good power-supply regulation is desirable for achievement of the best performance from any linear amplifier. A power supply that can deliver, say, 1500 volts at a load current of 200 ma, but which allows the voltage to rise to 1800 volts at the resting or static current of the Power Peaker amplifier will cause even the stand-by dissipation within the GL-811-A to exceed its rating—this will mean a short and unsatisfactory life for the tube. Design of a satisfactory power supply is discussed in G-E HAM NEWS, Vol. 7, No. 2 and THE RADIO AMATEUR'S HANDBOOK.

The type of load presented by a linear amplifier with single sideband input is identical to that of a class B modulator stage. To the information given in Vol. 7, No. 2 should be added that dynamic regulation of the power supply be considered also. Without going into details, one will end up with a really satisfactory plate power supply by following the design information given (especially with regard to input chokes, which affects "static" regulation) and then increasing the size of the output capacitor of the filter to a value considerably more than that required for satisfactory ripple performance.

Generally speaking, a power supply which has sufficient input choke to take care of static regulation needs only a single capacitor to meet the ripple requirement. This is provided the total value of capacitance is sufficient to iron out syllabic voltage fluctuations created by the intermittent load characteristic imposed by speech. At W2KUJ, where the Power Peaker was tested, an output capacitance of 25 mfd is used in the power supply to obtain good dynamic voltage regulation. An input choke of 60 henries is used to obtain good static regulation.

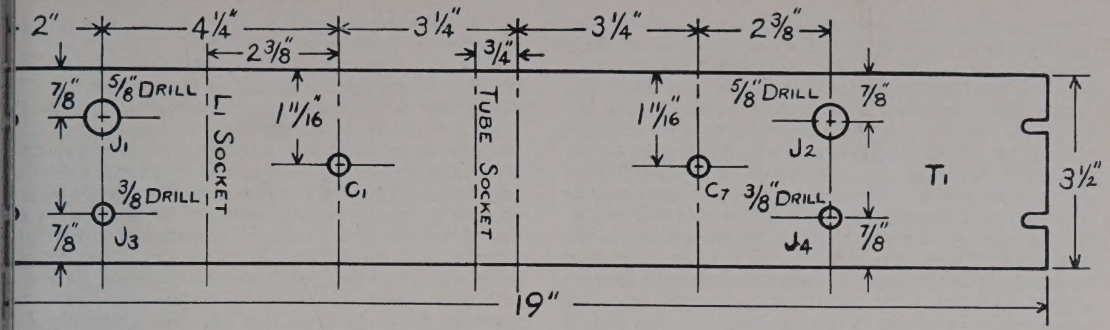

Fig. 4. Panel layout of the Power Peaker (Front Elevation)

Of course, transformer, rectifier tubes, and chokes sufficient current rating (about 200 ma for the wer Peaker) and filter condensers of adequate volt- e rating should be used.

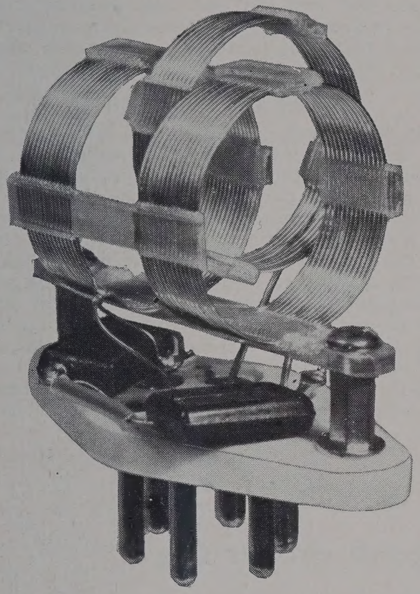

Fig. 5. Modification of grid tank coil

INITIAL TUNE-UP PROCEDURE

After checking the wiring and construction, apply ower to the filament circuit. Insert the GL-811-A its socket and connect the plate cap. Do not apply late voltage—in fact, disconnect the plate power upply from the terminal board for the present. Plug the set of coils covering the band you intend to perate and plug in a 0–50 ma meter in the grid current jack (J3). With power applied to the filament, is normal to see about 2 or 3 ma grid current with o excitation.

Arrange to supply excitation to the amplifier at the esired frequency. Start with the center link loosely oupled and tune the grid circuit to resonance as ndicated by maximum grid current. Set the neutralizng condenser about 90 degrees open and check grid ircuit resonance. The amount of excitation used at his time is not critical—anywhere from 15 ma to 50 a (maximum) will do. Adjust the coupling so that his order of magnitude is reached. If a single-sideand suppressed carrier exciter is used, it must be elivering some sort of a signal. A tone modulation, nbalanced carrier, or some reproducible signal will uffice.

NEUTRALIZATION

Disconnect the grid-current meter temporarily, but leave an open-circuited plug in the grid-current jack. Tune the plate tank circuit to resonance or near resonance as indicated by a lamp bulb connected to a loop of wire coupled to the plate coil, an oscilloscope connected to the output jack (use a one-turn tap on the coil) or any other neutralizing stunt you prefer. When fully neutralized, tuning the plate circuit through resonance will not affect the grid circuit. This may be verified by coupling the neutralizing indicator to the grid tank and tuning the plate circuit through its resonance point noted earlier.

With the amplifier neutralized, the plate supply may be connected, the grid-current meter reconnected, and a plate-current meter (0–250 ma) plugged into the cathode current jack (J4). With no excitation, the static plate current will be about 35 ma with 1500 volts applied. It will be noted that the static grid current will drop appreciably when plate voltage is applied. This is normal.

MATCHING AND LOADING

For further test, it is necessary to provide a load for the Power Peaker. Failure to do so will result in damaged coils. A dummy load which has the same resistance as your antenna is ideal for making coupling adjustments. Do not attempt to use incandescent lamp-bulb as a load because its resistance depends greatly on its temperature. An oscilloscope is also needed to check linearity and power when making a test with a two-tone signal. (See S. G. Reque, Linear R.F. Amplifiers, QST, May 1949, and R. W. Ehrlich, How To Test and Align a Linear Amplifier, QST, May 1952.)

Adjust the single-sideband exciter used as a driver for two-tone operation. Feed this signal into the input jack (J1), at a low level at first and connect the output link to a suitable load. Arrange the oscilloscope so that it can read the r.f. signal across the load. Enough signal will be available to see with the r.f. applied directly to the deflection plates. Apply plate voltage and resonate the grid tank (maximum grid current) and the plate tank (maximum load voltage) with fairly loose coupling to the output circuit.

(CAUTION—HIGH VOLTAGE! ALTHOUGH THE POWER PEAKER HAS BEEN DESIGNED WITH SAFETY IN MIND, IT IS WELL TO RECOGNIZE THE FACT THAT HIGH VOLTAGE IS USED AND THAT ALL "BACK OF THE PANEL" ADJUSTMENTS SHOULD BE MADE AFTER MAKING CERTAIN THAT THE HIGH-VOLTAGE SUPPLY IS NOT ONLY OFF BUT THAT THE FILTER CONDENSERS ARE DISCHARGED. WE DON'T WANT TO LOSE ANY OF OUR READERS JUST YET. STICK AROUND AND FIND OUT HOW WELL THE POWER PEAKER REALLY WORKS. 'NUFF SED?)

An arrangement should be made whereby the exciting signal can be turned off and on conveniently while making loading and matching adjustments. Do not run the test signal any longer at a time than is necessary to see the oscilloscope display and appraise it. Increase the input signal by either increasing the exciter output, or, the coupling in the grid circuit until the peaks of the two-tone output signal show definite flattening. Keeping the input signal at the level where flattening occurs, increase the coupling of the output by moving the tap up on L4 until the flattening disappears. Go a little further with this coupling. Next, increase the input signal until flattening again occurs and then increase the output coupling and so on. The tuning of plate and grid circuits should be checked for maximum output for each coupling adjustment made. You will note as the job progresses that the peak amplitude of the output signal keeps increasing. Along with this increased output you will note that the plate current has been increasing and so has the grid current. The stopping point is reached when either:

(a) The exciter can no longer deliver an undistorted two-tone signal, or,

(b) The plate current, with a two-tone test signal, has reached a value around 165 ma.

When condition (b) is reached, the tune-up procedure is completed, however, condition (a) requires an investigation of the exciter. Make certain that the Power Peaker is presenting a favorable load to the exciter. This is just a matter of juggling the coupling from the exciter and into the amplifier along with the exciter gain control if it has one. A peak driving power of about 2.5 watts is required, so if the exciter can deliver 5 watts peak power you have only to present the right load to the exciter.

The grid current under correctly loaded condition (b), will be somewhere around 20 ma with a total cathode current of 185 ma. Do not become concerned if the grid current is less than this amount, but if it is appreciably higher, increase the plate coupling or reduce the input signal or both.

If the procedure outlined has been followed carefully, the amplifier is loaded in an optimum manner. This may be checked by increasing the coupling to the output tank and noting the decrease in r.f. output signal (with fixed drive) and a slight decrease in grid current. Conversely, with fixed drive, decreasing the coupling from optimum will cause an increase in grid current and a flattening of the two-tone peaks as the signal passes through the amplifier. The plate current will drop. Bear in mind the objective is to load the amplifier for maximum output power for any given drive condition up to the maximum input current stated for condition (b). The objective is *not* to load the amplifier simply for maximum input, since the efficiency depends on the loading.

Although reading the tune-up procedure may raise several points not covered, remember that doing the job is probably not as bad as reading about it. The procedure is quite simple, as experience will show, and you will find that the description is quite detailed, perhaps needlessly so. Correct loading is essential to realize maximum output and efficiency together with low distortion.

OPERATING INFORMATION

Very little can be added here to what you already have learned in matching and loading the Power Peaker. Substitution of an antenna for the dummy load and a brief two-tone test with the oscilloscope as a monitor puts you on the air. Never try to exceed with speech signals the maximum peak level attained with the two-tone test. Not only will this fail, but also the quality of your single-sideband signal will be degraded. But worse than that, such practice destroys one of single-sideband's best points—a really narrow, minimum-interference, maximum intelligibility, signal. The Power Peaker linear amplifier can do a good job. Give it a chance and keep your sidebands clean.

Designer's CORNER

tank circuits Q's

We have mentioned at several places in the article on the Power Peaker something about tank circuit Q's, which possibly might have left some of our readers wondering what significance it all has in the design and operation of radio gear. The fact is that operating Q's have a very profound effect on the performance of most of the equipment we have, so a little working knowledge of the subject might serve as a useful guide in the selection of components and operating conditions in equipment we hams use every day. Do not blame us if you are moved to check into some of your gear after reading this discussion and make changes which improve the operation (more output, less TVI, cooler tubes, and the like) of equipment at your station.

The term "Q" is applied to the ratio of reactive power (wattless power) in a circuit to real power. From this basic definition of Q follows many interesting corollary relations in electrical circuits, although the concept is not in the least limited to the field of electricity. Immediately one can say that the Q of resistance is zero, and that the Q of a perfect coil or condenser is infinite. These are the absolute limits of Q's, but they are broad enough to provide plenty of room for error—or design, whichever way you may look at it.

What can a person do about Q if he buys a coil that has a Q of 250, and the designer of a circuit says such and so circuit should have a Q of 25? Are the manufacturers kidding; are they soaking us for a lot of Q we do not need; or does the designer of the circuit think that any old coil will do if it will fit into the coil socket? No, the manufacturer is talking about his *product* when he says its Q is 250; the designer is talking about his *circuit* which generally involves more than the coil alone, and he should know enough about it to pick components which are the right ones for the job. One of the fundamental properties of a coil of wire is its inductance. Disregarding distributed capacity (which can become a headache sometimes), the reactance of a coil is proportional to the product of its inductance and the quency at which it is operated. Pure reactances nice to talk about, but coils are not actually 0% pure reactances by the time you buy or make e—the wire has resistance! This resistance is nerally distributed throughout the coil, as is the ictance, but let us think of it as being all drained wn to the bottom of the coil in one chunk of pure istance, leaving pure reactance at the top. If the ictance portion of this *series* circuit of pure react- ce and pure resistance has a value of 250 ohms, d the resistance is one ohm, the Q of the coil is 0; or, concisely,

$$Q\ \text{coil} = \frac{\text{Reactance (X)}}{\text{Resistance (R)}} = \frac{250}{1} = 250.$$

is is consistent with the basic definition given lier. What we have said about coils is equally true capacitors, but it turns out that condensers can made with much higher Q's than coils generally ve, so we worry about coils a little more than capaci- s when speaking about Q's of the circuit elements use.

Well, if we apply 1000 volts RMS to this coil hav- a reactance of 250 ohms and a resistance of one m (the impedance is very, very nearly 250 ohms, t 251 ohms), 4 amperes of current will flow through th reactance and resistance, and the *real* power the coil is 16 watts (which shows up as heat) and reactive power is 4000 volt-amperes, so called to tinguish wattless power from real power. The at generated in this transaction represents energy t—or at least energy converted from electrical m (that can be used conveniently) into heat at warms the coil and does not ever show up as ergy in the antenna. What of it? Why worry about watts lost when we have 4000 volt-amperes reactive wer in the coil? If volt-amperes were what we were er, this would be fine. Think of it—4000 volt- iperes that cost only 16 watts! A good bargain? t bad if we know our P's (powers) and Q's, but at is the rest of the story. The circuit designer can w take over where the coil builder left off.

As we all know, a capacitor in parallel with a coil ikes a tuned circuit. It turns out that at the onant frequency of this circuit the reactance of capacitor is equal to the reactance of the coil. we tune our coil with a capacitor having a Q of 00 (not unusual) we can truly neglect the 8/10 of a tt lost in the equivalent resistance of the capacitor npared with the 4000 volt-amperes of reactive wer (not lost—yet) in the coil and capacitor, and 16 watts loss in the coil. Now let us add a fourth cuit element to the reactance and resistance of coil and the reactance of the capacitor comprising tuned (tank) circuit we are talking about. Let make this one a resistance, and let us put it across condenser of the tank circuit. If 1000 volts is ll supplied across the coil, it now appears across resistance and the capacitor as well. A little over watts has already been accounted for in the coil d condenser so what about the new resistor? Well, current of E/R flows in it, and power *is* consumed the resistance—no doubt about it. It is already etty hot!

How much power goes into this resistor? That is easy one. The power is

$$P\ \text{(watts)} = E^2/R = \frac{1{,}000{,}000}{R\ \text{(Ohms)}},$$ since the voltage E is 00 volts, RMS, by hypothesis. If R is 5000 ohms, e power is 200 watts and the circuit Q is now

$$Q\ \text{(circuit)} = \frac{\text{Reactive Power}}{\text{Real Power}} = \frac{4000}{216} = 18.5$$ accord- g to our basic definition of Q stated at the outset.

Let us not be quite so crude about it. Suppose the *uivalent* of this resistance is put across the capaci- r by *coupling* a load to the coil and adjusting the coupling until the power delivered to the load is 200 watts. If the coupling job did not disturb the tuning, the circuit Q is still 18.5, and the generator feeding this circuit is unable to detect the difference. It still has to supply 216 real watts as before and 4000 volt-amperes to the coil and the capacitor of the tank circuit. In fact, the generator does not even feel the 4000 VA in the coil because the 4000 VA in the capacitor happens to cancel the reactive power of the coil! That is co-operation on a pretty big scale, but nobody should be surprised about it—this is what happens at resonance. Has the bargain evaporated? Not entirely, although the 4000 VA has slipped through our fingers somehow. Pfoof! That was wattless power anyway. We did get 200 watts of good output from our circuit that loaded the generator to 216 watts, so the circuit efficiency is

$\eta\ \text{(circuit)} = \frac{200}{216} \times 100 = 92.6\%$, a pretty fair bargain at that. Had we loaded the circuit to extract only 100 watts, the circuit efficiency would have been $100/116 \times 100 = 86.3\%$, not quite so good. The circuit Q in this case would have been 34.5. If the circuit were not loaded at all, the circuit efficiency would have been zero, with a Q of almost 250, about the same as that of the coil. Loading the circuit so that 400 watts is delivered would give a circuit efficiency of $100 \times \frac{400}{416} = 96.2\%$ with a circuit Q of 9.62. Which loading would you choose? To answer that we must consider the characteristics of the generator and the signal it generates.

If the generator had sinusoidal waveform (no harmonics) the tank circuit would not be needed at all, and so the load circuit efficiency would be very close to 100% at any power level. But the generators we are interested in are vacuum tubes running as class B or C amplifiers, generally. A class B amplifier delivers a signal that is only half of a sine wave, and a class C amplifier does even less. The tank circuit helps the tube, which delivers only half of a sine wave (or less), to deliver a whole sine wave to the load. The degree to which this is done is almost directly proportional to the operating Q of the circuit. Thus, the tank circuit serves as a much needed coupling device between the tube and the load, and by various adjustments of coupling, we can make a fixed value of load resistance present a chosen value of load into which the tube (generator) actually delivers power. A little power loss in the tank circuit is justifiable, since we have limited control over the actual load resistance and the tube characteristics; i.e., the optimum load for the tube itself. We have seen that the power output of the generator depends on the load resistance presented to it, in this case across the capacitor of the tank circuit. For a given tube and mode of operation (class A, AB, B, or C) there is a definite best loading. Too light a load will not allow a reasonable output power; too heavy a load, on the other hand, wastes power in the tube (generator) and makes it overheat. All of these factors indicate a compromise, with the circuit designer as referee. It has been found that circuit Q's of about 10 or more make the tube happy—accept power for half a cycle or less and deliver power for a whole cycle. The numerical example showed us that the higher circuit Q's had lower efficiencies (with a fixed coil Q) so this tends to push the choice of circuit Q down.

The response of a tuned circuit to harmonics is approximately $\frac{1}{nQ}$, where n is the order of the harmonic (2 for second, 3 for third, etc.), so this consideration makes a choice of high Q desirable. A good all-round choice of operating Q is from 12 to 15, a compromise to be sure. Now we do some juggling. We want to present the optimum load to the tube, but we must keep it happy. We also want to have good discrimination against harmonics present in the output of the tube. In addition, we want to waste as little of the tube's output power as possible; that is, we want good over-all efficiency. Having chosen the operating voltage for the tube, the optimum resonant load resistance is fixed. Taking this and a value of circuit Q around 12 to 15 we can solve for the reactance of the coil and the condenser by substituting values in the following equation:

$$\text{Reactance} = \frac{\text{Load Resistance desired}}{\text{Q (circuit)}}$$

This is the value that must be used to obtain the desired output power at good tube efficiency, at reasonable circuit efficiency, and with reasonable harmonic attenuation. Circuit Q affects all these things. The Q of the coil alone determines the power loss in the coil, once its reactance is established. Doubling the Q of the coil alone will cut the power loss in the coil itself to half—a desirable move for the sake of the coil—but this is not so easy, and the circuit efficiency will be raised only a little bit (from 96%, say, to 98%, a little difficult to detect on the scale of the output power). Doubling the coil Q will not affect *in the least* the loss occurring in the tube itself. That loss is determined by the load into which the tube works, and by the mode of operation; i.e., class A, B, or C.

It takes no magician to apply the foregoing information intelligently. In the Power Peaker amplifier, for example, the output circuit Q was chosen at about 15. (This will vary somewhat throughout a given band because of tuning.) The choice of 1500 volts (the highest allowed by the tube manufacturer) was made to get the greatest useable output power, and this sets the value of load resistance and coil reactance at any operating frequency. The numbers used in the foregoing numerical examples are quite close to those actually appearing in the Power Peaker amplifier. That is all there was to it. Easy? You betcha!

One more comment. If a Q of 12 or 15 is so good for the output circuit why was a Q of 25 chosen for the input (grid circuit) of the Power Peaker? Two main considerations guided this choice. The input load of the GL811-A depends somewhat on the loading in the output circuit. In order to have some latitude for error, the Q of the input circuit was made higher than actually necessary so that things would be on the safe side. The other consideration was this: the exciter, when coupled to the amplifier grid circuit, lowers the grid-circuit Q. Thus, it is quite probable that the working Q of the grid tank circuit will be around 15, after all.

Watch your P's and Q's. Keep your tubes happy, get more power out of your rig, lower the harmonic output, and save money in the choice of suitable components.

W2KUJ

CQ — CQ — CQ

Be sure to see the G-E ad, Page one, October issue of QST and CQ, announcing the new G-E Amateur award. Complete details will also appear in the NOV.-DEC., VOL. 7, NO. 6 issue of HAM NEWS.

Lighthouse Larry

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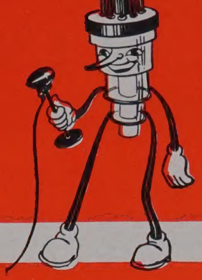
VEMBER—DECEMBER, 1952

VOL. 7—NO. 6



S/N-6 CASCODE 2 METER PRE-AMPLIFIER

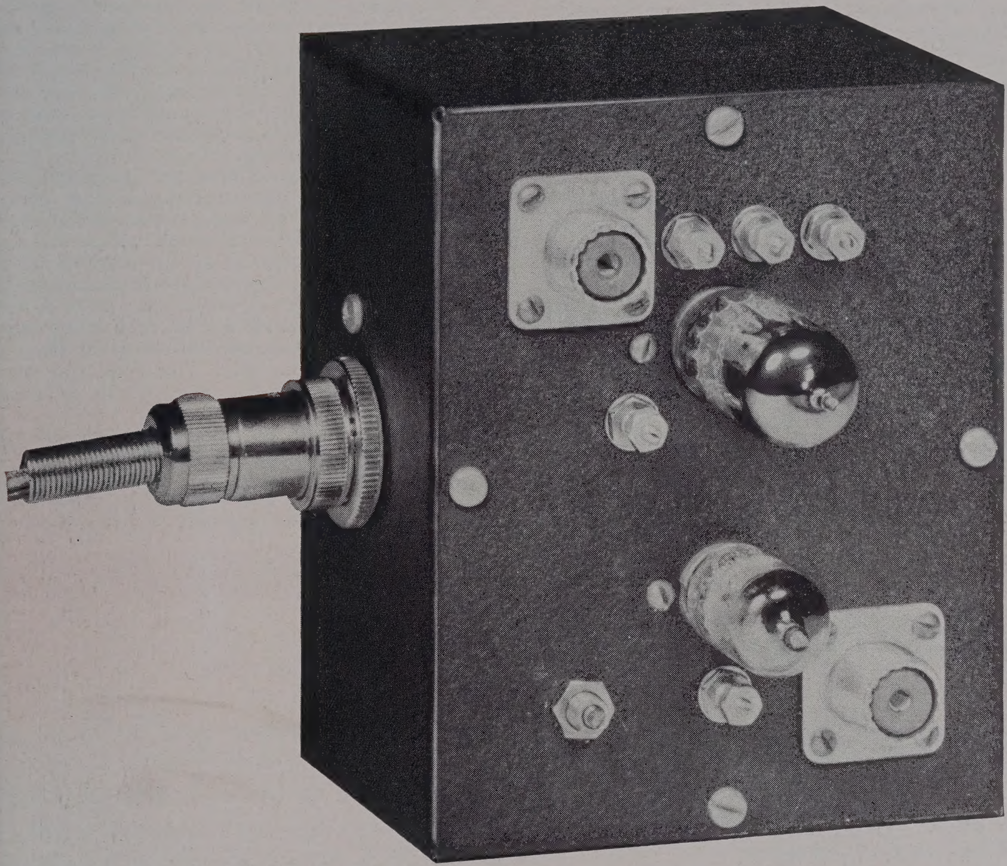


Fig. 1. Front view of the S/N-6 Cascode 2 Meter Pre-amplifier.

CQ — CQ — CQ

THE EDISON RADIO AMATEUR AWARD—SEE PAGE 6.

—Lighthouse Larry

ntents

S/N-6 Cascode 2 Meter Pre-amplifier.................................pages 1–5
The Edison Radio Amateur Award.................................page 6
Sweeping the Spectrum.................................page 7
Technical Information (6BK7).................................page 8

THE S/N-6 CASCODE 2 METER PRE-AMPLIFIER

Here it is fellows! Another pre-amplifier from the shack of W2RDL, designer of the popular R-9'ER, which appeared in HAM NEWS Vol. 1 No. 4. This 2 meter cascode pre-amplifier utilizes the recently announced 6BK7 in a neutralized circuit which matches the output to the receiver.

This is W2RDL's answer to those many requests for a cascode amplifier using this new tube. It is relatively simple to construct and the average amateur should have no trouble in making it work properly. One word of caution—the circuit constants and layout must be followed faithfully.

The newcomer and the oldtimer will find that the S/N-6 will improve the signal-to-noise ratio—6 DB noise figure—give added gain—18 to 24 DB—and pull in what used to be weak stations.

—*Lighthouse Larry*

GENERAL DESCRIPTION

The S/N-6 cascode 2 meter pre-amplifier is entirely self contained (except power supply) in a 3 x 4 x 5 inch metal box. All parts mount directly on the rear of the front panel so that construction is easy and straightforward. The 6BK7 and 6AK5 r-f tubes are mounted horizontally on the front panel. Coaxial fittings are used for the r-f input and output connections. All tuning adjustments of the coils are made from the front of the panel.

The plate voltage required for the two tubes is low —150 volts d-c—and can be taken off the communications receiver. Filament voltage required is 6.3 volts a-c or d-c at 0.625 amperes.

DESIGN CONSIDERATIONS

Many 2 meter converters and receivers, today, lac two important features which are necessary for DX work at this frequency. These two features are (1 high signal-to-noise ratio (low noise figure) (2) gain Of these two, high signal-to-noise ratio is the mos important. An amplifier could increase the gain but i it did not improve the signal-to-noise ratio nothin would be achieved—that is, you would notice an in crease in signal level but at the same time the nois level would be increased proportionally.

The opposite case would be an amplifier with a hig signal-to-noise ratio with no increase in gain. Thi would be a decided advantage over the first amplifie in that the signal would appear louder to the ear, how ever, the S meter would show no increase in signal level These two amplifiers are exaggerated cases, sinc fortunately practically all r-f amplifiers improve th signal-to-noise ratio to a certain extent and give a increase in gain.

In the design of the S/N-6, the above two feature were deemed to be of utmost importance. Since th first stage of any r-f amplifier, receiver, or converter i the most important from a signal-to-noise ratio stand point, it was given careful design consideration. Th cascode circuit was chosen because if properly designe it will produce a high signal-to-noise ratio. A pentod could be used in this circuit for high gain, however it would produce more noise because of the curren division at the screen grid. Therefore, the low-nois twin triode type 6BK7, particularly designed fo cascode circuits, was chosen.

The selection of a triode was not too difficult. A first a pentode connected 6AK5 feeding a pentode con nected 6AK5 in a cascade circuit was calculated fo signal-to-noise ratio. Under optimum conditions thi calculated to be approximately 9 DB (noise figure

Electrical Circuit

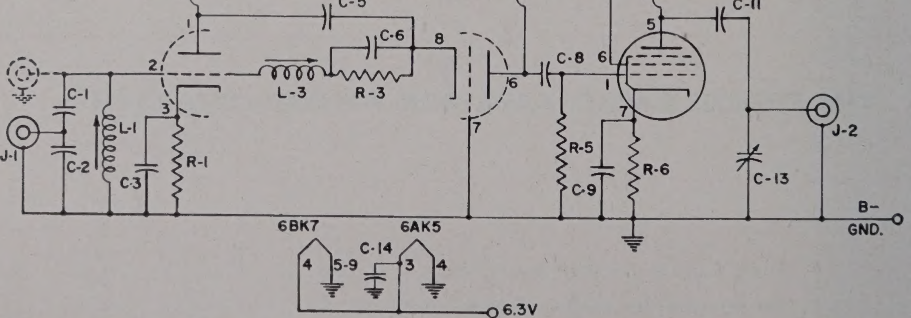


Fig. 2. Circuit diagram of the S/N-6 pre-amplifier.

which was good but still too high. Then a type 6BK7 cascode feeding another 6BK7 cascode was calculated and the over-all signal-to-noise ratio was approximately 5 DB (noise figure). This was considered to be very good so the original design was started. After the circuit was designed on paper a laboratory model was constructed. This model had a tendency to break into oscillation. Therefore, two other models were constructed with different layouts to overcome this condition. Each of these models still showed the tendency to break into oscillation. Methods were devised to eliminate the oscillations, but it was felt they were too difficult for the average amateur to duplicate and achieve a stable unit. A pentode connected 6AK5 was then considered for the second stage to replace the second 6BK7. This combination, 6BK7-6AK5, calculated to 6 DB (noise figure) under optimum conditions. Three models were constructed each with a slightly different layout. None of the layouts were unstable, however, the one illustrated in Fig. 3 was considered the best and simplest for construction.

Another feature considered and incorporated was to make the front end broadband. This is very desirable for this band, since it eliminates the necessity for retuning when going from one end of the 2 meter band to the other. Also the output impedance was made adjustable so that a proper match could be made to the receiver. This is important since any mismatch to the receiver may tend to decrease the signal-to-noise ratio.

CIRCUIT DETAILS

Refer to the schematic circuit diagram shown in Fig. 2. The cascode section of the unit, which consists of both triode sections of the 6BK7, is of the parallel d type. This type of circuit has the advantage over the series-type circuit, in that a lower plate supply voltage is required and the heater-cathode voltage is lower.

The input circuit has been designed to accommodate either a 70 ohm or 300 ohm unbalanced line. For 70 ohm input, jack J1 is connected as shown. For 300 ohm input, the center pin of J1 is connected to the junction of C1 and L1 as indicated by the dotted lines. Capacitors C1, and C2 and inductance L1 together with the attached antenna form a broadband input network to cover the entire two meter band. Once L1 is adjusted for the center of the band no further adjustments are necessary.

The plate circuit of the first triode section of the 6BK7 consists of L2, C4, C5, and R2. Capacitor C4 and Resistor R2 form a decoupling network for the supply voltage. The inductance L2, is of primary importance in that it has a decided bearing on the signal-to-noise ratio. If it is replaced by an r-f choke, the signal-to-noise ratio may be very low. Inductance L2 tunes fairly broad but it should be adjusted for the center of the band by the brass slug.

Capacitor C5 feeds the signal into the cathode of the second triode section of the 6BK7. Part of this signal is fed through L3, the neutralizing inductance, which forms a parallel resonant circuit with the grid-to-plate capacitance of the first triode section. This effectively tunes out the grid-to-plate capacitance which is necessary for high signal-to-noise ratio and good stability.

The second triode section of the 6BK7 is operated as a grounded grid stage. Bias voltage for this section is obtained by the cathode current flowing through R3. Capacitor C6 effectively by-passes the r-f around this bias resistor. The plate circuit of this section incorporates another decoupling network R4 and C7. It is also tuned to resonance at the center of the band by the brass slug of inductance L4.

CIRCUIT CONSTANTS

(All resistors and capacitors ±20% tolerance unless specified otherwise)

C, C2	15 mmf, zero-temperature, tubular ceramic (Centralab TCZ-15)
C, C4, C5, C6, C, C8, C12	1000 mmf, high-K tubular ceramic (Centralab D6-102)
C, C10, C14	1000 mmf, high-K disc ceramic (Centralab DD-102 or Sprague 5HK-D1) (See text)
C1	25 mmf, zero temperature, tubular ceramic (Erie NPOL-25, ±10%)
C3	12-120 mmf, mica compression padder (EL-MENCO 612)
R, R3	56 ohms, ½ watt
R, R4	220 ohms, 1 watt
R	2400 ohms, ½ watt
R6	180 ohms, ½ watt
R7	2700, 1 watt
L1, L2, L4	3 turns No. 24 enamel wire, spaced diameter of wire, wound on Millen type 69047 coil form, brass slug.
L3	6 turns No. 24 enamel wire, spaced diameter of wire, wound on Millen type 69047 coil form, brass slug.
L5	2 turns No. 24 enamel wire, spaced diameter of wire, wound on Millen type 69047 coil form, brass slug.
J1, J2	coax jacks
6BK7 socket	9-pin miniature (vector type 8-N-9T)
6AK5 socket	7-pin miniature (Cinch-Erie, 1000 mmf capacitors built in) (See text)

The final stage consists of a type 6AK5 operating as a pentode. The input to this stage is conventional. The plate circuit utilizes another decoupling network formed by resistor R7 and capacitor C10. Incorporated, also, is an impedance matching network formed by inductance L5, capacitors C11 and C13. Inductance L5 is adjusted by the brass slug to resonance at the center of the band, then with the receiver connected to J2, variable capacitor C13 is adjusted for the loudest signal.

COMPONENT PARTS

Particular attention should be given to Figs. 3 and 4 which show clearly the 6BK7 socket and the 6AK5 socket. The 6BK7 socket is manufactured by Vector, type 8-N-9T. It is recommended this type be used as it permits easy mounting of the components and short leads. The 6AK5 socket is manufactured by Cinch-Erie and is of a special type. This particular socket has 1000 mmf by-pass capacitors built in on all pins except pins 1 and 5. No information was available on the type number during the construction of this model, therefore, another was constructed using a standard National type XOA-C-7 ceramic socket and by-passing pins 3, 6 and 7 with 1000 mmf disc type capacitors (C9, C10, C14) to ground with shortest leads possible. No difference was noted between the two models, therefore, the builder can use whichever is available.

Capacitors C1, C2, C11, and C13 should be of the value and type specified. The other condensers specified can either be of the tubular type or disc type. It is highly recommended the tubular type be used, with the exception of those used in by-passing the 6AK5 mentioned above, to facilitate short and direct connections.

The coil forms used are type 69047 manufactured by the James E. Millen Manufacturing Co. This type of coil form has an adjustable brass slug. It is very important that brass or copper slugs be used as iron slugs will ruin the Q at this frequency. It is recommended the coil forms specified be used.

All of the resistors specified are of standard composition type with tolerances of ±20%.

CONSTRUCTION DETAILS

It is recommended that the mechanical layout shown in Figs. 3, 4 and 5 be followed faithfully. This layout was found to be the best from an electrical and mechanical standpoint.

The S/N-6 is constructed on a 3 x 4 x 5 inch box with removable front and back panels. All of the components are mounted on the back of the front panel as illustrated in Figs. 3 and 4. Before mounting the components all of the black crackle paint should be removed. This is very important to insure good ground connections. Also the lip on the box, to which the front panel attaches, should be cleaned of all paint to further insure a good ground connection.

Dimensions are given in Fig. 5 for locating the various holes. No dimensions are given for the socket holes or input and output jack. These will depend on the type the builder uses.

As will be noted in Figs. 3 and 5, coils L1, L2, and L3 are in line with the input jack J1 and are mounted close to the Vector socket. Coil L4 is mounted above and to the right of the 6BK7 socket with coil L5 mounted to the right of the 6AK5 socket. If the dimensions outlined in Fig. 5 are followed, the coils will mount close to the sockets permitting short and direct connections. In winding the coils, leave approximately one inch of wire at the ends for soldering.

The power plug, which is clearly seen in Fig. 1, can either be mounted on the side of the box or on the rear panel. This is left up to the discretion of the builder as its location is not critical.

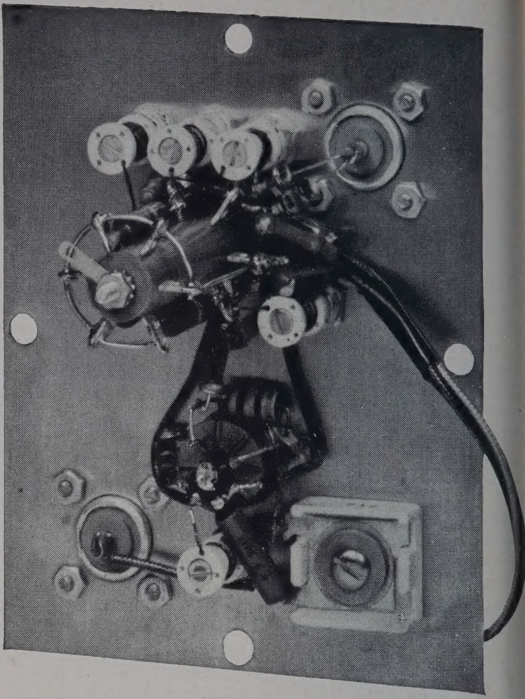


Fig. 3. Rear view of front panel illustrating layout.

WIRING DETAILS

In wiring the S/N-6, the work will be much easier i a small-tip soldering iron is used. As will be note from the photographs, the capacitors and resistors ar compactly grouped around the Vector socket whic makes the soldering operation a little difficult if a large tip iron is used.

In wiring the 6BK7 stage, use is made of the lug on the Vector socket as tie points. The lug above pi number 1 is used as a tie-point for C4, L2, and R The lug above pin 6 is used as the tie-point for C L4, and R4. The lug above pin 9 is the tie-point fo C6, R3 and L3. The lugs at the top of the form are a tied together. This is used as the B plus tie-point Resistors R2 and R4 and capacitor C12 are placed be tween the two sets of lugs on the form with one en tied to the B plus tie-point. This results in a neat an workmanlike appearance. Use is also made of the fou lugs on the socket mounting ring. These are used a ground tie-points for C2, C3, C4, C7, R1, and L1 an also for pin 7.

The 6AK5 socket is wired in the conventional manne using short direct connections. Soldering lugs placed a the socket mounting holes are used as ground ti points.

ALIGNMENT

The alignment procedure is straightforward an simple to perform. The output of the pre-amplifie should be connected to the antenna terminals of th receiver by a short piece of cable. The cable should no be over twelve inches long and must be shielded t avoid picking up extraneous signals.

With the receiver tuned to 146 megacycles, a signa of this frequency should be fed into the antenna inpu (either 70 ohm or 300 ohm input). This signal can b obtained from a signal generator, transmitter, or

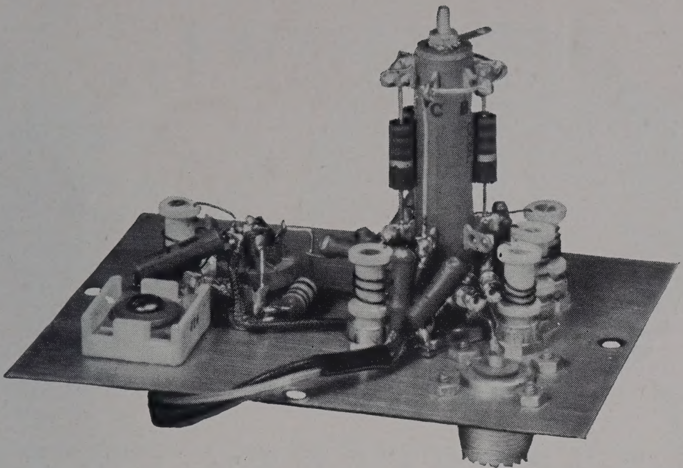


Fig. 4. Side view of front panel illustrating layout.

ly loud signal from another amateur station can used. If the last two methods are used, the signal uld be close to the center of the band.

Vith the signal fed into the input, capacitor C13 l the brass slug of inductance L5 should be adjusted maximum signal. Next the brass slug of inductance should be adjusted for maximum signal. The brass g of L2 is adjusted next in the same manner followed the adjustment of L1. In adjusting L1 and L2, it l be found that they tune quite broad. Next, the itralizing inductance, L3, should be adjusted for ximum signal. This may be tricky if the inductance L3 is too high. In this case there will be a tendency oscillate, with a large increase in signal just before illation starts. This condition will also cause the plifier to have a rather narrow bandwidth. So check bandwidth if you suspect L3 is wrong.

After the above procedure has been followed, it ould be repeated and the inductances realigned if essary.

Once the above alignment procedure has been com- ted, no further adjustments are necessary while erating your receiver.

OPERATING INFORMATION

To coin an old expression, "the receiver is no better than the antenna," applies equally well here. Use a good antenna, and one with the proper impedance—either 52 ohms or 300 ohms unbalanced. If you do this and the pre-amplifier is properly constructed, you can expect a noise figure of 6 DB and a signal gain of 18-24 DB.

On-the-air tests were conducted at W2RMA's shack over a period of a month. During this time the S/N-6 was put through various tests and suffice to say it proved its value. Signals were heard which could not be detected without the S/N-6. Also, a *definite* improvement in signal-to-noise was noted on weak stations which could be detected without the pre-amplifier. This was to be expected, however, since any pre-amplifier, or receiver with a noise figure of 6 DB is an exceptionally good one. (Compare this with the average communication receiver which is liable to have a noise figure of 30 DB!)

To those of you who build this 2 meter pre-amplifier, be sure to use good quality parts, good workmanship and above all follow the article faithfully and you'll enjoy lots of DX.

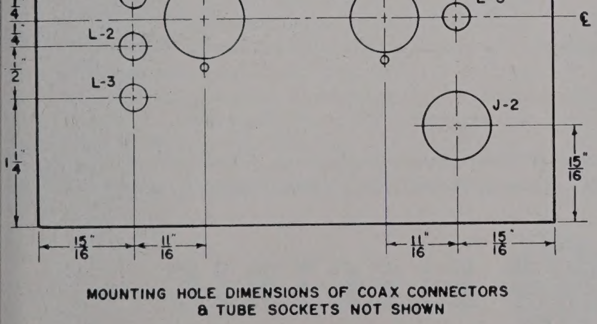
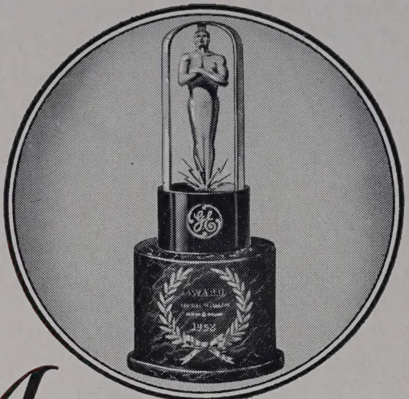


Fig. 5. Panel layout of the S/N-6 (Back elevation).



Announcing

THE EDISON RADIO AMATEUR AWARD

To gain greater recognition for the many vital and humane public services performed by radio amateurs, G. E. offers the Edison Radio Amateur Award for 1952

Who is eligible for the Edison Radio Amateur Award: Radio amateurs eligible for nomination will be those men and women who, during 1952, have performed a meritorious public service on behalf of an individual or a group, in a disaster area, in civil defense, or in similar situations.

Nominations may be made by any amateur, club, association, or individual familiar with the service performed.

Winner of the award will receive the Edison Radio Amateur trophy in a public ceremony in a centrally located metropolitan city. National recognition will be accorded the winner of the award, and as a token of appreciation for his service, General Electric will present him with a 24-hour watch to clock DX accurately.

How to nominate a candidate: To nominate a candidate for the award, you need only submit his name, address, call letters, and a description of the service performed.

Entries will be reviewed by a distinguished group of impartial judges, and the decisions of the judges will be based on (1) the greatest benefit to the individual or group (2) the greatest amount of ingenuity and sacrifice displayed in performance of the service.

Your candidate must hold a radio amateur's license issued by the F. C. C., Washington, D. C., and the service must have been performed while he was pursuing his hobby as an amateur within the continental limits of the United States.

Your letter must be postmarked not later than December 31, 1952.

Judges who will decide which candidate's achievement is most worthy of the award, are:

Mr. E. R. Harriman, President, The American Red Cross.

Mr. G. E. Sterling, Commissioner, Federal Communications Commission.

Mr. G. L. Dosland, President, American Radio Relay League.

Winner will be announced on or before March 1, 1953, and the award will be publicly bestowed soon thereafter.

Employees of the General Electric Company may nominate candidates for the Edison Radio Amateur Award, but are not permitted to receive the award.

Choose your candidate . . . prepare your letter of nomination . . . and mail to Edison Award Committee, Tube Dept., General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC

166-1B10

SWEEPING *the* SPECTRUM

Have you nominated your candidate for the Edison dio Amateur Award sponsored by the G-E Tube partment? I hope all of you readers saw our October in CQ and QST announcing this award. For those o may have overlooked it we have reprinted the on the preceding page.

hope you readers will take time out and nominate amateur who you feel is worthy of this award. We nt to find the amateur who has performed a meri- ious public service and inform Mr. and Mrs. John Public of his deed so that they will realize that ama- rs *can* and *will* perform such services whenever y are called upon. We want the public to know t amateurs of today are always ready to give un- ishly of their time to help in any emergency whether be floods, tornadoes, snow storms or relaying medical ormation to save a person's life; also they are doing uable work in Civil Defense and other similar public vices. We want the public to look upon the amateur as the one who causes Tennessee Valley Indians t a person whom they can call upon for help.

This is another step forward in promoting better derstanding and goodwill between Mr. and Mrs. John Public and the amateur.

So how about it fellows! Let's find this amateur. nd your nominating letter in as soon as possible. member all letters must be postmarked not later an December 31, 1952.

⁂ ⁂ ⁂

Would you like to see an issue of **HAM NEWS** voted to the calculation of signal-to-noise ratio? This uld be a mathematical treatise on the subject by 2RDL and would entail the design and calculations typical r-f amplifiers. No calculus or higher mathe- tics would be used—only simple algebra which I am e most of you readers know. If you would like to see h an article appear in this publication, drop me a e. If enough votes are received, it will appear in a ure issue.

⁂ ⁂ ⁂

Here is a very interesting definition of "flea power." is that power generated by a flea weighing one milli- am and jumping 20 inches high every 5 seconds—a microwatt. Just think, it would take one million fleas jumping in harmony to produce one watt!

⁂ ⁂ ⁂

A news release that passed over my desk recently told of the demonstration of a "transistorized" megaphone which amplified the normal speaking voice to a volume comparable to a cheerleader's most strident yell. The article goes on to say "The transistors in the megaphone operate from tiny batteries, the size of a miniature cigarette lighter, eliminating the use of bulky, high-voltage batteries and the need for an external power supply. The little batteries are enclosed with the transistors in the amplification unit. The new unit has a volume control which permits the adjustment of the normal speaking voice from a raucous shout to an inaudible whisper." Can you just picture the vest-pocket transistorized modulator of nineteen umpteen modulating that KW! What about the modulation transformer? I dunno———.

Another news release told of experimental transistors operating at temperatures well above the boiling point of water—270 degrees. That's pretty hot! And a recent article mentioned that some transistors can operate up in the megacycles. This new field of electronics is certainly developing at a fast pace.

Would you like to see an article in **HAM NEWS** on a "transistorized" receiver or transmitter? It is hoped that not too far in the distant future we may have such an article.

⁂ ⁂ ⁂

Here's another newsy item. The G.E. Company will supply electronic signalling equipment for automatic and simultaneous control of civil air raid warning instruments throughout the state of Delaware. The equipment produces electronic tones, which when broadcast over the State Police radio system, are useful only to special civil defense radio receivers. The receivers are connected to air raid warning devices and on receiving the tones, activate the device so as to produce the standard civil air raid warning signals.

It's comforting to know that some people in the United States are not just sitting around and glibly saying "it can't happen here." This brings up a mighty interesting question—What are you as an amateur doing for Civil Defense? Have you joined your local Civil Defense organization?

—Lighthouse Larry

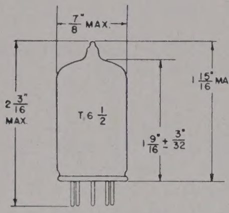
Technical Information **6BK7**

GENERAL DESCRIPTION

Principal Application: The 6BK7 is a miniature twin triode designed primarily for use as a cascode amplifier at frequencies below approximately 300 megacycles. The electrical characteristics of the 6BK7 are similar to those of the 12AV7; however, the 6BK7 incorporates an internal shield which reduces the feed-through capacitance between sections and thus makes the 6BK7 especially suited for use in cascode amplifiers and other applications in which a minimum of coupling betwee the two sections is required.

Cathodes:	Coated Unipotentia
Heater Voltage (A-C or D-C)	6.3 Volt
Heater Current	0.45 Amper
Envelope:	T-6½, Glas
Base:	E9-1, Small Button 9-Pi
Mounting Position:	Any

PHYSICAL DIMENSIONS

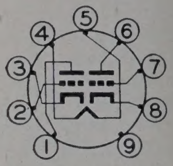


RTMA 6-2

TERMINAL CONNECTIONS

Pin 1 – Plate (Section 2)
Pin 2 – Grid (Section 2)
Pin 3 – Cathode (Section 2)
Pin 4 – Heater
Pin 5 – Heater
Pin 6 – Plate (Section 1)
Pin 7 – Grid (Section 1)
Pin 8 – Cathode (Section 1)
Pin 9 – Internal Shield*

BASING DIAGRAM



RTMA 9AJ
BOTTOM VIEW

MAXIMUM RATINGS

DESIGN CENTER VALUES: (EACH SECTION)

Plate Voltage	300	Volts	Plate Dissipation	2.7	Watt
Negative D-C Grid Voltage	50	Volts	Heater-Cathode Voltage**	90	Volt

---

* It is recommended that pin 9 be grounded.

** When the 6BK7 is used as a cascode amplifier and the two sections are connected in series, the heater-cathode voltage of th grounded-grid stage may be as high as 250 volts maximum with the heater negative with respect to the cathode.

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TUBE DEPARTMENT, ELECTRONICS DIVISION

GENERAL ELECTRI

SCHENECTADY 5, N. Y.

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R. L. VOELLER, W2WPV—*EDITOR*

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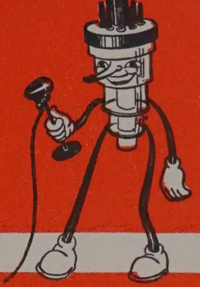

DX LOG

REVISED JAN. 15, 1953

Official Countries—Check Lists for States, Call Areas, Zones & Continents

STATE CHECK LIST

State	Station Worked	Date	Band	A1 A3	QSL	
					Sent	Rec'd
bama						
zona						
ansas						
ifornia						
orado						
nnecticut						
aware						
rida						
orgia						
ho						
nois						
iana						
va						
nsas						
ntucky						
uisiana						
ine						
ryland						
ssachusetts						
chigan						
nnesota						
ssissippi						
ssouri						
ontana						
braska						
vada						
w Hampshire						
w Jersey						
w Mexico						
w York						
. Carolina						
. Dakota						
hio						
klahoma						
regon						
ennsylvania						
hode Island						
Carolina						
Dakota						
ennessee						
exas						
tah						
ermont						
irginia						
ashington						
est Virginia						
isconsin						
yoming						

ZONE CHECK LIST

Zone	Station Worked	Date	Band	A1 A3	QSL	
					Sent	Rec'd
1						
2						
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7						
8						
9						
10						
11						
12						
13						
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36						
37						
38						
39						
40						

CALL AREA CHECK LIST

Call Area	Station Worked	Date	Band	A1 A3	QSL	
					Sent	Rec'd
W1						
W2						
W3						
W4						
W5						
W6						
W7						
W8						
W9						
W0						

CONTINENT CHECK LIST

Continent	Station Worked	Date	Band	A1 A3	QSL	
					Sent	Rec'd
Africa						
Asia						
Europe						
N. America						
S. America						
Oceania						

OFFICIAL COUNTRIES

Prefix	Country	Continent	Station Worked	Date	Band	A1 A3	QSL	
							Sent	Rec'd
AC3	Sikkim	Asia						
AC4	Tibet	Asia						
AG2	(See No. 78)							
AP	Pakistan	Asia						
C*	China	Asia						
C3	Formosa	Asia						
C9	Manchuria	Asia						
CE	Chile	S. America						
CE7Z, LU, VP8	Antarctica	Oceania, Africa & S. America						
CM, CO	Cuba	N. America						
CN2, KT1	Tangier Zone	Africa						
CN8	French Morocco	Africa						
CO	(See No. 9)							
CP	Bolivia	S. America						
CR4	Cape Verde Islands	Africa						
CR5	Portuguese Guinea	Africa						
CR5	Principe, Sao Thome	Africa						
CR6	Angola	Africa						
CR7	Mozambique	Africa						
CR8	Goa (Portuguese India)	Africa						
CR9	Macau	Asia						
CR10	Portuguese Timor	Oceania						
CT1	Portugal	Europe						
CT2	Azores Islands	Europe						
CT3	Madeira Islands	Africa						
CX	Uruguay	S. America						
DL, DJ	Germany	Europe						
DU	Philippine Islands	Oceania						
EA	Spain	Europe						
EA6	Balearic Islands	Europe						
EA8	Canary Islands	Africa						
EA9	Spanish Morocco	Africa						
EA0	Spanish Guinea	Africa						
EI	Eire (Irish Free State)	Europe						
EL	Liberia	Africa						
EP, EQ	Iran (Persia)	Asia						
EQ	(See No. 34)							
ET	Ethiopia	Africa						
F	France	Europe						
FA	Algeria	Africa						
FB8	Amsterdam & St. Paul Islands	Africa						
FB8	Kerguelen Islands	Africa						
FB8	Madagascar	Africa						
FC	Corsica	Europe						
FD	French Togoland	Africa						
FE8	French Cameroons	Africa						
FF8	French West Africa	Africa						
FG	Guadeloupe	N. America						
FI8	French Indo-China	Asia						
FK8	New Caledonia	Oceania						
FKS8	(See No. 113)							
FL8	French Somaliland	Africa						
FM8	Martinique	N. America						
FN	French India	Asia						
FO	French Oceania (e.g. Tahiti)	Oceania						
FP8	St. Pierre & Miquelon Islands	N. America						
FQ8	French Equatorial Africa	Africa						
FR7	Reunion Island	Africa						
FU8, YJ	New Hebrides	Oceania						
FY7	French Guiana & Inini	S. America						
G	England	Europe						
GC	Channel Islands	Europe						
GD	Isle of Man	Europe						
GI	Northern Ireland	Europe						
GM	Scotland	Europe						

L lists this prefix as "unofficial" but will recognize it for DXCC credit.

OFFICIAL COUNTRIES

No.	Prefix	Country	Continent	Station Worked	Date	Band	A1 A3	QSL	
								Sent	Re
62	GW	Wales	Europe						
63	HA	Hungary	Europe						
64	HB	Switzerland	Europe						
65	HC	Ecuador	S. America						
66	HCB	Galapagos Islands	S. America						
67	HE	Liechtenstein	Europe						
68	HH	Haiti	N. America						
69	HI	Dominican Republic	N. America						
70	HK	Colombia	S. America						
71	HL	Korea	Asia						
72	HP	Panama	N. America						
73	HR	Honduras	N. America						
74	HS	Siam	Asia						
75	HV	Vatican City	Europe						
76	HZ	Saudi Arabia (Hedjaz & Nejd)	Asia						
77	I	Italy	Europe						
78	I, AG2, MF2	Trieste	Europe						
79	I5, MD4, MS4	Italian Somaliland	Africa						
80	I6, MD3, MI3	Eritrea	Africa						
81	IS	Sardinia	Europe						
82	JA, KA	Japan	Asia						
83	JA0	Bonin & Volcano Islands	Asia						
84	JY	Jordan	Asia						
	K	(See No. 213)							
	KA	(See No. 82)							
85	KB6	Baker, Howland & American Phoenix Islands	Oceania						
86	KC6	Caroline Islands	Oceania						
87	KC6	Palau Islands	Oceania						
88	KG4	Guantanamo Bay	N. America						
89	KG6	Mariana Islands	Oceania						
90	KH6	Hawaiian Islands	Oceania						
91	KJ6	Johnston Island	Oceania						
92	KL7	Alaska	N. America						
93	KM6	Midway Islands	Oceania						
94	KP4	Puerto Rico	N. America						
95	KP6	Palmyra Group, Jarvis Island	Oceania						
96	KR6	Ryukyu Islands (e.g. Okinawa)	Asia						
97	KS4	Swan Island	N. America						
98	KS6	American Samoa	Oceania						
	KT1	(See No. 10)							
99	KV4	Virgin Islands	N. America						
100	KW6	Wake Island	Oceania						
101	KX6	Marshall Islands	Oceania						
102	KZ5	Canal Zone	N. America						
103	LA	Norway	Europe						
104	LA	Svalbard (Spitzbergen)	Europe						
105	LU	Argentina	S. America						
106	LX	Luxembourg	Europe						
107	LZ	Bulgaria	Europe						
108	M1	San Marino	Europe						
	MB9	(See No. 113)							
	MD3	(See No. 80)							
	MD4	(See No. 79)							
	MD5	(See No. 134)							
	MD6	(See No. 217)							
	MF2	(See No. 78)							
	MI3	(See No. 80)							
	MP4	(See No. 212)							
109	MP4	Kuwait	Asia						
110	MP4	Trucial Oman	Asia						
	MS4	(See No. 79)							
111	OA	Peru	S. America						
112	OD5	Lebanon	Africa						
113	OE, MB9, FKS8	Austria	Europe						
114	OH	Finland	Europe						
115	OK	Czechoslovakia	Europe						
116	ON	Belgium	Europe						
117	OQ	Belgian Congo	Africa						

OFFICIAL COUNTRIES

Prefix	Country	Continent	Station Worked	Date	Band	A1 A3	QSL	
							Sent	Rec'd
OX	Greenland	N. America						
OY	Faeroes	Europe						
OZ	Denmark	Europe						
PA	Netherlands	Europe						
PJ	Netherlands West Indies	S. America						
PK1, 2, 3	Java	Oceania						
PK4	Sumatra	Oceania						
PK5	Netherlands Borneo	Oceania						
PK6	Celebes & Molucca Islands	Oceania						
PK6, 7	Netherlands New Guinea	Oceania						
PX	Andorra	Europe						
PY	Brazil	S. America						
PZ	Netherlands Guiana	S. America						
SM	Sweden	Europe						
SP	Poland	Europe						
ST	Anglo-Egyptian Sudan	Africa						
SU, MD5	Egypt	Africa						
SV	Greece	Europe						
SV	Crete	Europe						
SV5	Dodecanese (e.g., Rhodes)	Europe						
TA	Turkey	Asia						
TF	Iceland	Europe						
TG	Guatemala	N. America						
TI	Costa Rica	N. America						
TI	Cocos Island	N. America						
	Soviet Union							
UA1, 3, 4, 6	European Russian Socialist Federated Soviet Republic	Europe						
UA9, 0	Asiatic Russian S.F.S.R.	Asia						
UB5	Ukraine	Europe						
UC2	White Russian Soviet Socialist Republic	Europe						
UD6	Azerbaijan	Asia						
UF6	Georgia	Asia						
UG6	Armenia	Asia						
UH8	Turkoman	Asia						
UI8	Uzbek	Asia						
UJ8	Tadzhik	Asia						
UL7	Kazakh	Asia						
UM8	Kirghiz	Asia						
UN1	Karelo-Finnish Republic	Europe						
UO5	Moldavia	Europe						
UP2	Lithuania	Europe						
UQ2	Latvia	Europe						
UR2	Estonia	Europe						
VE, VO*	Canada	N. America						
VK	Australia (inc. Tasmania)	Oceania						
VK1	Cocos Islands	Oceania						
VK1	Heard Island	Africa						
VK1	Macquarie Island	Oceania						
VK9	Papua Territory	Oceania						
VK9	Territory of New Guinea	Oceania						
VK9	Norfolk Island	Oceania						
VO	(See No. 160)							
VP1	British Honduras	N. America						
VP2	Leeward Islands	N. America						
VP2	Windward Islands	N. America						
VP3	British Guiana	S. America						
VP4	Trinidad & Tobago	S. America						
VP5	Cayman Islands	N. America						
VP5	Jamaica	N. America						
VP5	Turks & Caicos Islands	N. America						
VP6	Barbados	N. America						
VP7	Bahama Islands	N. America						
VP8	(See No. 8)							
VP8	Falkland Islands	S. America						
VP8	South Georgia	S. America						
VP8, LU	South Orkney Islands	S. America						

foundland and Labrador DXCC credit will be given if VO contact was made prior to April 1, 1949.

OFFICIAL COUNTRIES

No.	Prefix	Country	Continent	Station Worked	Date	Band	A1 A3	QSL	
								Sent	Rec
181	VP8	South Sandwich Islands	S. America						
182	VP8, LU	South Shetland Islands	S. America						
183	VP9	Bermuda Islands	N. America						
184	VQ1	Zanzibar	Africa						
185	VQ2	Northern Rhodesia	Africa						
186	VQ3	Tanganyika Territory	Africa						
187	VQ4	Kenya	Africa						
188	VQ5	Uganda	Africa						
189	VQ6	British Somaliland	Africa						
190	VQ8	Chagos Islands	Africa						
191	VQ8	Mauritius	Africa						
192	VQ9	Seychelles	Africa						
193	VR1	Gilbert & Ellice Is. & Ocean Is.	Oceania						
194	VR1	British Phoenix Islands	Oceania						
195	VR2	Fiji Islands	Oceania						
196	VR3	Fanning Is. (Christmas Is.)	Oceania						
197	VR4	Solomon Islands	Oceania						
198	VR5	Tonga (Friendly) Islands	Oceania						
199	VR6	Pitcairn Island	Oceania						
200	VS1	Singapore	Asia						
201	VS2	Malaya	Asia						
202	VS4, ZC5*	British North Borneo	Oceania						
203	VS5	Brunei	Oceania						
204	VS5	Sarawak	Oceania						
205	VS6	Hong Kong	Asia						
206	VS7	Ceylon	Asia						
207	VS9	Aden & Socotra	Asia & Afr.						
208	VS9	Maldive Islands	Asia						
209	VS9	Sultanate of Oman	Africa						
210	VU	India	Asia						
211	VU4	Laccadive Islands	Asia						
212	VU7, MP4	Bahrein Island	Asia						
213	W, K	United States of America	N. America						
214	XE	Mexico	N. America						
215	XZ	Burma	Asia						
216	YA	Afghanistan	Asia						
217	YI, MD6	Iraq	Asia						
	YJ	(See No. 55)							
218	YK	Syria	Asia						
219	YN	Nicaragua	N. America						
220	YO	Roumania	Europe						
221	YS	Salvador	N. America						
222	YU	Yugoslavia	Europe						
223	YV	Venezuela	S. America						
224	ZA	Albania	Europe						
225	ZB1	Malta	Europe						
226	ZB2	Gibraltar	Europe						
227	ZC3	Christmas Island	Oceania						
228	ZC4	Cyprus	Asia						
	ZC5	(See No. 202)							
229	ZC6	Palestine	Asia						
230	ZD1	Sierra Leone	Africa						
231	ZD2	Nigeria	Africa						
232	ZD3	Gambia	Africa						
233	ZD4	Gold Coast, Togoland	Africa						
234	ZD6	Nyasaland	Africa						
235	ZD7	St. Helena	Africa						
236	ZD8	Ascension Island	Africa						
237	ZD9	Tristan da Cunha & Gough Is.	Africa						
238	ZE	Southern Rhodesia	Africa						
239	ZK1	Cook Islands	Oceania						
240	ZK2	Niue	Oceania						
241	ZL	New Zealand	Oceania						
242	ZM	British Samoa	Oceania						
243	ZP	Paraguay	S. America						
244	ZS1, 2, 4, 5, 6	Union of South Africa	Africa						
245	ZS3	Southwest Africa	Africa						
246	ZS7	Swaziland	Africa						

**ZC5 being used in this country and is recognized for DXCC credit.*

OFFICIAL COUNTRIES

Prefix	Country	Continent	Station Worked	Date	Band	A1 A3	QSL	
							Sent	Rec'd
ZS8	Basutoland	Africa						
ZS9	Bechuanaland	Africa						
3A1, 2	Monaco	Europe						
3V8	Tunisia	Africa						
4X4	Israel	Asia						
5A2, 3	Libya	Africa						
9S4	Saar	Europe						
(No regularly assigned prefixes)	Aldabra Islands	Africa						
	Andaman and Nicobar Is.	Asia						
	Bhutan	Asia						
	Clipperton Island	N. America						
	Comoro Islands	Africa						
	Easter Island	S. America						
	Fridtjof Nansen Land (Franz Josef Land)	Europe						
	Ifni	Africa						
	Jan Mayen Island	Europe						
	Marion Island	Africa						
	Mongolia	Asia						
	Nepal	Asia						
	Qatar	Asia						
	Rio de Oro	Africa						
	Tannu Tuva	Asia						
	Tokelau (Union) Islands	Oceania						
	Wrangel Islands	Asia						
	Yemen	Asia						

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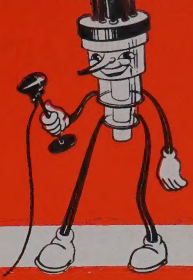
TUBES



Ham News

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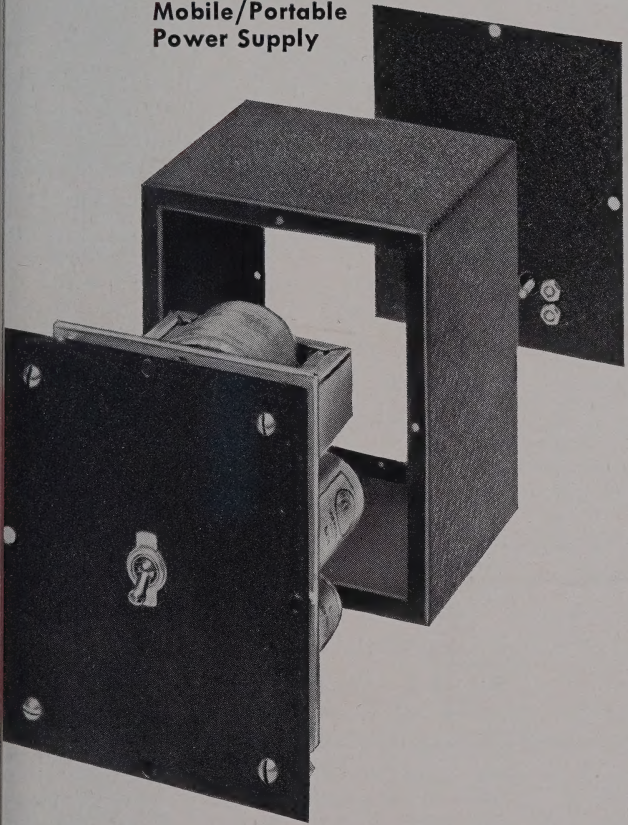
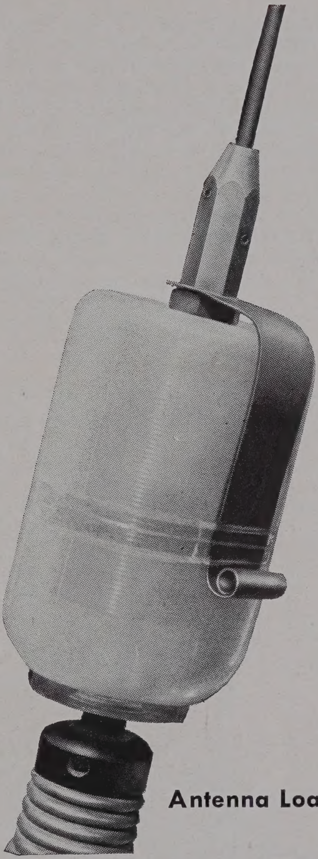
RCH-APRIL, 1953 VOL. 8—NO. 2

POWER IN . . . and POWER OUT

Mobile/Portable Power Supply





Antenna Loading Coil

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MOBILE/PORTABLE POWER SUPPLY

Here's a handy mobile/portable power supply designed for use with any one of a number of pieces of gear described in G-E HAM NEWS during the past few years—the Emergency-Portable Rig, the Mobile Modulator, the 6-Meter Receiver, the 6-Meter Transmitter, the 6-Meter CD Receiver, and the Mobile Marine Receiver.

This new power supply provides exceptional voltage regulation and incorporates some advanced thoughts in design. It's worth looking over—especially by fellows inclined to frown on vibrator and selenium rectifier circuits.

—Lighthouse Larry

The Emergency/Portable Power Supply puts out 300 volts at 100 milliamperes and −40 volts bias—all from a 4 x 5 x 6-inch utility box. Input at full load is 6 volts d-c at 7.65 amperes. Efficiency is 67%. The supply is light weight, and voltage regulation is exceptional.

Compromising on the 300-volt, 100-milliampere size gives an adequate design which will not overburden the average battery. The supply to be described evolved after serious consideration of the most frequently observed faults of the customary vibrator type supply: Voltage regulation usually poor—with tremendous jumps even between half-load and full-load conditions; vibrator life short due to contact failure when self-rectifying type circuits are used; and conversion efficiency surprisingly low—often less than 50%.

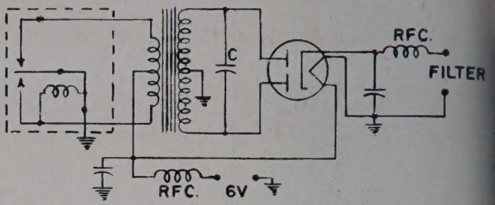


Figure 1

A typical nonsynchronous vibrator supply is sho
in Figure 1. The vibrator is a reed with heavy conta
that switches the current from one side of the prima
of the power transformer to the other. The reed
driven by a small magnet coil in one direction, and th
springs back by itself to make the other contact—in
manner similar to the common door bell.

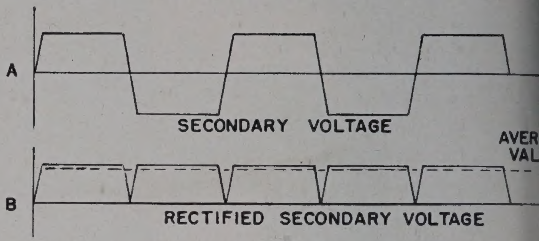


Figure 2

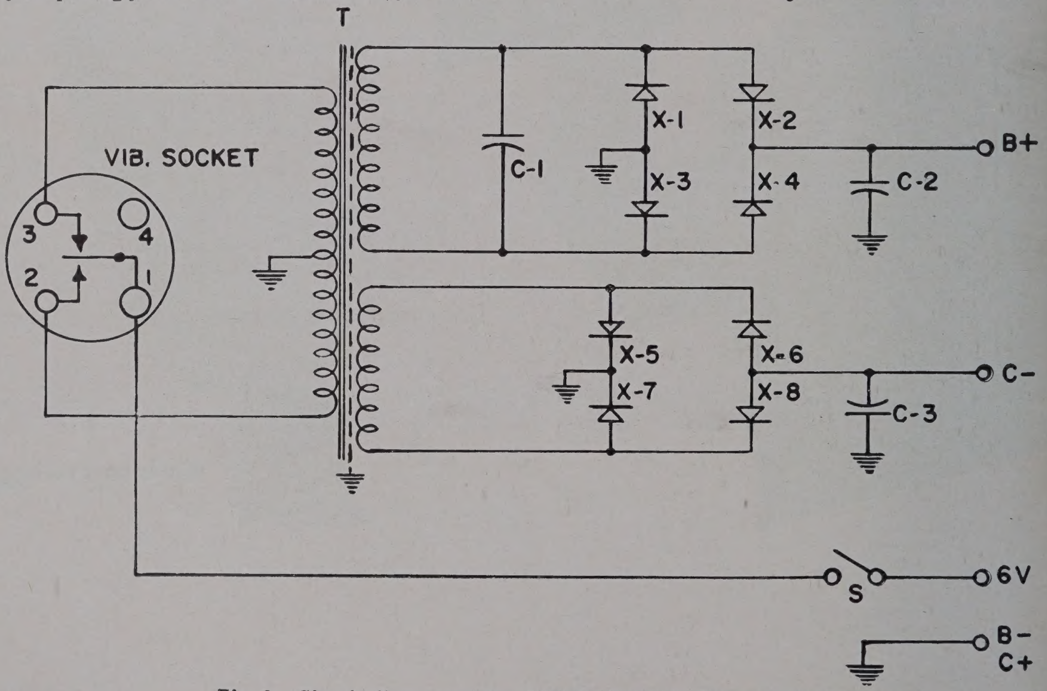


Fig. 3—Circuit diagram of the Mobile/Portable Power supply.

C_1—.01 mf 400-volt plastic buffer
C_2—20 mf 450-volt (Sprague EL-2)
C_3—50 mf 50-volt dry electrolytic
Vib—Vibrator unit (Cornell-Dubilier 5314)
S—SPST toggle switch

T—Vibrator transformer. Pri.: 6 v. DC, 7.5 A; sec.: 300
100 ma.; 40 v. bias winding. (Ballastran BC-385—
text)
X_1-X_4—100 ma 380-volt selenium rectifier (GE-6RS5GH1)
X_5-X_8—selenium rectifier modified to one plate (see text)

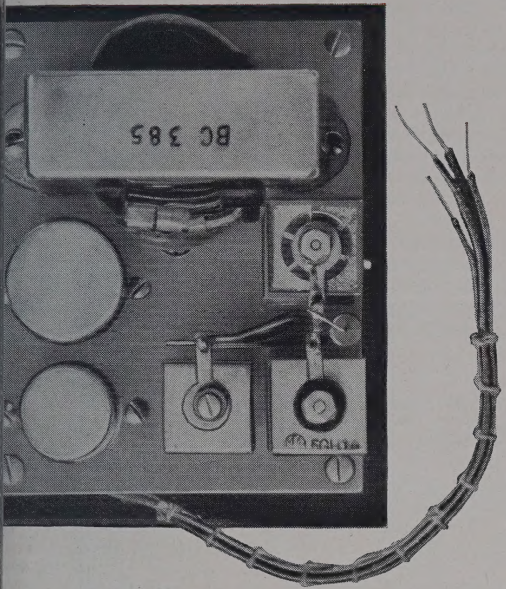


Figure 4

his action produces the effect of square-wave a-c ation of the primary circuit—which of course is ed over to the secondary. See Figure 2 (A). Ca- tor C in Figure 1 absorbs the inductive kick which rs when the current flow is reversed. (If not sup- sed, this kick would put "spikes" on the edges of square wave, produce high surge currents through rectifiers and cause sparking at the vibrator acts.)

hen the secondary voltage is rectified by a full- e system, the output appears as in Figure 2 (B). iously, filtering this output is a relatively easy task. ddition, this wave form is extremely easy on recti- since the peak voltage is just slightly higher than output voltage—resulting in relatively low peak ents through the rectifiers as compared with the l power supply.

a typical circuit, only half the transformer is in at any one time—thus making the transformer er inefficient for its size. While nothing can be done it the primary without going into a complicated ator structure, it is possible to make full use of the ndary with a bridge rectifier circuit as shown in ire 3. Just by employing the bridge circuit, the ndary can handle 140% of the volt-amperes of the er-tapped circuit occupying the same space. Or, versely, the secondary of a bridge rectifier trans- ner need occupy only 70% of the space required for nter-tapped full-wave secondary of the same rating.

s noted above, square-wave pulses make relatively peaks—thus permitting use of replacement-type selenium rectifiers rated at 380 volts peak inverse voltage.

The selenium rectifier bridge offers further advantages: Improved voltage regulation due to low forward resistance as compared with vacuum rectifiers; and the fact no warm-up time is required—which may be important in some applications.

The transformer used in the supply illustrated has a high voltage winding rated at 300 volts and 100 milliamperes and a bias winding for supplying minus 40 volts.*

The bias winding on the transformer is also equipped with a full-wave selenium bridge to provide a convenient bias supply for Class B audio systems and/or r.f. final circuits. This eliminates the C battery normally used in mobile or portable work.

Buffer condensers (C1 in Figure 3) usually are rated at 1500 volts. However, if they buff properly, as this one does, the high voltage rating is not necessary. Still, cautious constructors may wish to use a 1500-volt capacitor. We might note, also, that handbook vibrator circuits often call for a resistor of, say, 5000 ohms in series with the buffer condenser to limit the secondary current to a safe value should the buffer break down. Although this was not deemed necessary in the power supply herein described, it is another safety factor that may be employed if the builder wishes.

CONSTRUCTION DETAILS

The power supply illustrated fits into a 4 x 5 x 6-inch utility box with an on-off toggle switch on the front and a 4-terminal barrier-type strip on the back as shown on the front cover of this issue of G-E HAM NEWS. All other components are mounted on a plate of 1/8-inch aluminum which just clears the lips of the utility box and stands off 1 inch behind the front cover as shown. Figures 4 and 5 show the layout. The 50-microfarad bias filter condenser is mounted under the plate between a terminal lug and one of the ground lugs at the base of the high voltage filter condenser.

Aside from careful placement of the components to get them all in the box, the only critical construction

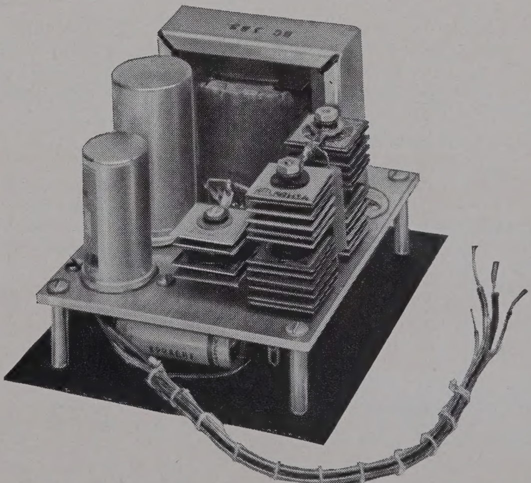


Fig. 5—Four-plate rectifier stack is the bias bridge.

---

ade by Ballastran Corporation, 1701 N. Calhoun Street, rt Wayne 7, Ind. This company now also has designed for E HAM NEWS readers a special modulation transformer C-384) for use in the Mobile Modulator of the July-August, 50 issue of G-E HAM NEWS. This modulator has made a with many hams. Transformers tested show high efficiency d low distortion. Ratings are: Pri. 10,000 ohms, plate-to- ate; Sec. 10,000/7,000/5,000 ohms at 60 ma. DC unbalanced ad. Power output, 10 watts.

problem is the modification of a fifth selenium rectifier to provide the bridge circuit for the bias voltage.

This small bridge is the four-plate stack seen at the left in Figure 5. The first step in taking apart a Model GE-6RS5GH1 rectifier is to pry up the washer clamp at the top. The plates may then be separated with a knife blade, but care must be taken not to disturb the "spider" sealed to each plate. Insert the knife between spider and adjoining washer—not between spider and plate.

The GE-6RS5GH1 rectifiers are marked with a splash of red on the cathode terminal—to which, of course, associated B plus leads are attached. In making up the small bias bridge, it is important to note which sides of the plates are cathode. In the GE-6RS5GH1, the "spider" is sealed to the cathode side. Thus to make a full-wave bridge with one plate in each leg, four of the plates are restacked with washers and suitable lugs. Note the cathodes are joined in the center as indicated in Figure 6.

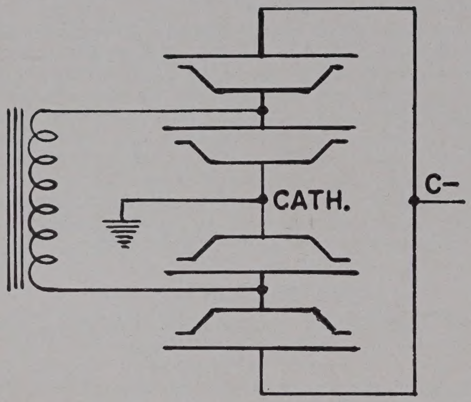


Figure 6

In wiring the power supply note that in the high voltage bridge the ground connection goes to rectifier anodes—whereas in the bias supply the ground goes to rectifier cathodes.

PERFORMANCE

Figure 7 illustrates voltage regulation of this supply under actual test loads. A check for ripple showed .25 volt at no load and 4 volts at full load, peak-to-peak. A one-hour heat run left the supply cool to the touch. Efficiency checked out at 67%.

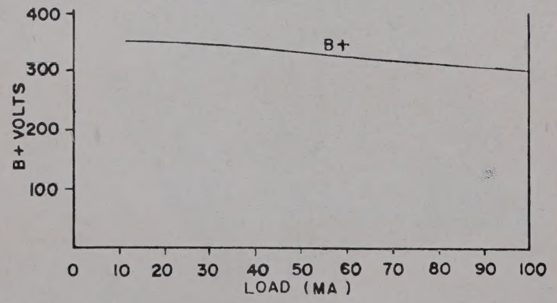


Fig. 7—Voltage regulation under test loads from 12 to 100 ma.

ANTENNA

The construction of mobile radio equipment requir
in general, a long series of compromises between e
ciency and practicality—compromises which start w
the power supply and carry right on through to t
antenna system.

The wonder of it is that we can construct any ki
of equipment at all rugged enough to withstand vehi
vibration and bounce and yet capable of converti
the prosaic 6-volt d-c intended for lights and igniti
to r-f waves which travel hundreds and even thousan
of miles.

On the higher ham frequencies, where antennas a
smaller, problems involving stability become of fi
order importance. But on the bands below 10 mete
where stability is easier to lick, the most plagui
problem is perhaps the radiator itself.

60-FOOT WHIP?

On 75 meters—the most popular low-frequen
mobile band—a 60-odd-foot quarter-wave anten
somehow just doesn't fit into the design of an au
mobile! So we compromise again and use a loading c
to keep the quarter-wave electrical length and at t
same time reduce the physical length.

The compromise, however, *is* a compromise—in t
finest sense of the word. It solves the physical probl
but hinders us radiowise, because it cuts down t
radiation efficiency of the antenna. And after all, wh
we are primarily interested in getting is the "sou
out into the air.

But as long as we must keep the antenna heig
down to 8 or 10 feet, we want to get the best deal

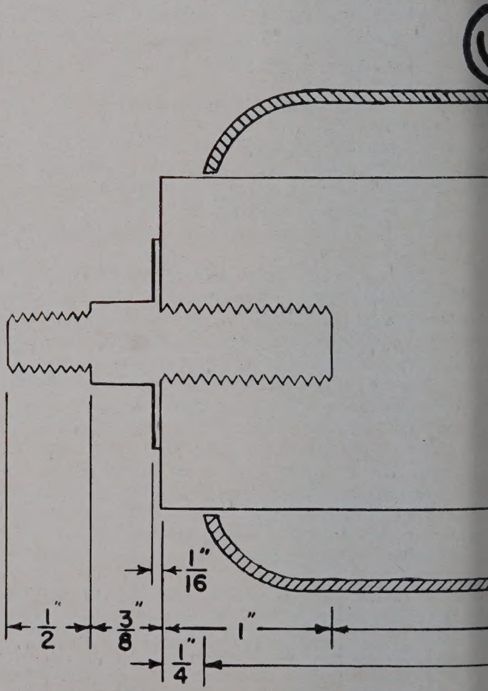


Fig. 1—How the plastic bottle

ING COIL

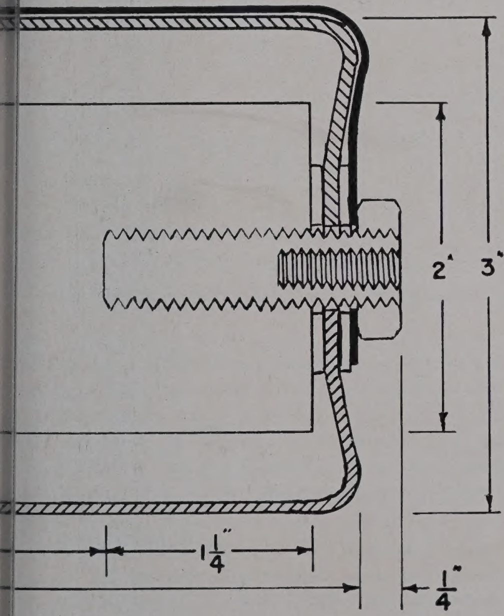
. Thus the object to aim for is a coil with high Q a means of critical tuning.

he coil illustrated is wound on 2-inch polystyrene , grooved on a lathe and drilled and tapped at both s to receive special fittings fabricated to insert the in a standard ⅜-inch, 8-foot antenna whip and ng mount. (The whip and mount illustrated are rd products.) This particular coil has 53 turns and originally designed for 3950 kcs work. Coil con- nts will vary from one installation to another, of rse.

he good insulating quality of the poly rod—which tributes to high Q—is maintained in nasty weather use of a 16-ounce round polyethylene bottle as a tective cover. The bottle used in this installation is laxpac. Such bottles may be obtained at some drug- es, or from glass and plastic bottle distributors.

Iodification of the bottle offers no problems. Simply l a hole in the center of the bottom to pass the top ng, and cut off the top so as to leave an opening ch will fit snugly—but not airtight—over the tom end of the coil form.

uning a loading coil usually is a nasty job. Some ns place the coil inside a car's rear trunk to protect rom weather—and then find they must shut them- es inside the trunk to tune properly because the ition of the trunk door affects the loading. Taps are ky to adjust and open the way to contact trouble. ning slugs or metal or wire rings work well but are her difficult to manufacture or hard to get at under rotective cover.



fit on the loading coil described.

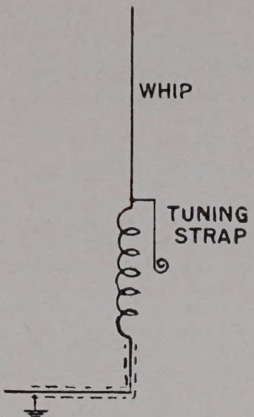


Fig. 2—Electrical connection of the tuning strap.

SARDINE CAN KEY TUNER

The coil illustrated tunes with a sardine can key! A tuning strap of soft copper is simple to make and install as shown. Tuning is even simpler.

After preliminary checks are made to obtain the proper number of turns on the loading coil for the frequency and whip to be used, get the rig putting out the maximum signal with the strap straight down. Then with a field strength meter set up as far away as practical, start rolling up the end of the strap with a sardine can key. Although the sardine can key was left on the model shown at first, the designer soon discovered that it offered an irresistable temptation to children and to other hams. The solution was to break off the end of the key, leaving it fork-shaped for easy removal.

When checking for maximum signal on the field strength meter, you should, of course, remove the key and stand away from the antenna. Although the strap provides relatively fine tuning, care still must be taken not to pass by the resonant point.

In rolling the strap, make sure it actually curls and that you are not pulling the entire strap away from the loading coil. For you will want to secure it with tape once you have it set—and you will not want the strap bent out so that fastening it with tape will once again change the tuning.

Although the strap lowers the Q of the coil slightly, it has been found the advantages of this construction and the ease of tuning far outweigh the loss of Q.

Of course, those with infinite patience can go on from here with capacitive "hats," "wheels," "cans" or "baskets"—and more power to them!

PARASITICS

In the schematic of the Mobile-Marine Receiver of the July-August, 1952, issue of G-E HAM NEWS two changes should be made: (1) The arm of SW-1A should be grounded; and (2) the connection between the cathode of the 6BE6 mixer and the junction point of R5 and C10 should be eliminated.

Tricks & TOPICS

TO TUNE A LOADING COIL

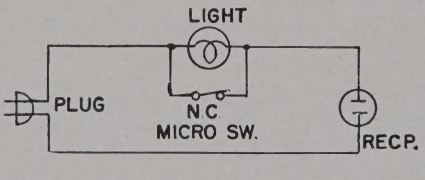
To vary a loading coil inductance over a range of approximately 75 kcs, use a single turn of heavy insulated wire twisted tightly around the coil. The writer used G-E Flamenol #14 with the ends bared and twisted together. Before final tightening, the shorted turn can be moved up and down the coil. The effect is minimum at the ends of the coil and maximum at the center. Wind your loading coil with several more turns than required to resonate the antenna at the lowest frequency—then move the shorted turn from one end toward the center until antenna resonance is obtained. On loading coils which are space wound or employ heavy wire, the shorted turn can be "screwed" up and down to find the resonant point.

MORLEY F. GOUGH, VE2GR

* * *

A 'STAND-BY' SOLDERING IRON

To prevent a 100-watt soldering iron from overheating, I use a normally-closed micro-switch which cuts a 100-watt lamp into the circuit when the iron is placed on the stand. The stand, lamp socket and switch are all mounted on a small square of wood together with a female a-c receptacle for the iron cord. The stand is hinged with a strap of metal at one end, while the other end of the stand rests on the micro-switch. On "stand-by," the iron keeps fairly hot and is ready for use a few seconds after being lifted off the switch. When the iron is in continuous use, a small block of wood is slipped under the free end of the stand next to the micro-switch to keep the switch from opening—thus maintaining full voltage on the iron.



CHARLES K. GABLER, W2CLU

* * *

SCHEMATIC TRACING AID

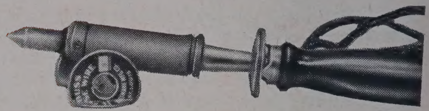
Whenever it is necessary to copy a drawing or print, dampen the paper with a few drops of lighter fluid. This makes the paper sufficiently translucent so the drawing can be traced—yet leaves no ring or spot when the fluid evaporates.

HARVEY MULLER

HANDY SOLDERING IRON STANDS

Instead of throwing away empty solder or fuse wi spools, we bend the ears over to make soldering iro stands. They take up less space than the regula stands, and there is always a backlog of extras.

HARRY J. MILLER



* * *

SOLDERING IRON SLEEVE

When soldering in close places, wrap an asbest sleeve around the iron to protect nearby parts. Th sleeve can be wired in place just medium-snug so th it can be slipped back or off when not needed.

HENRY JOSEPHS

* * *

SOLDERING TAPS ON COILS

The problem of soldering taps on coils where th turns are close together, without shorting to the adj cent turns, is a tough one. After several unsuccessf tries on an 80-meter 75-watt tank coil, I put strips aluminum foil through the coil on each side of the pla to be tapped. The type sold for food-wrapping is idea and enough thicknesses can be folded together to mak a snug fit between turns. After soldering, the aluminu slips out without trouble, leaving a neat and solid join A big advantage of the foil is that it can be bent bac easily to allow good contact between iron and join

CARL R. ZIMMER, W4WXP/2

* * *

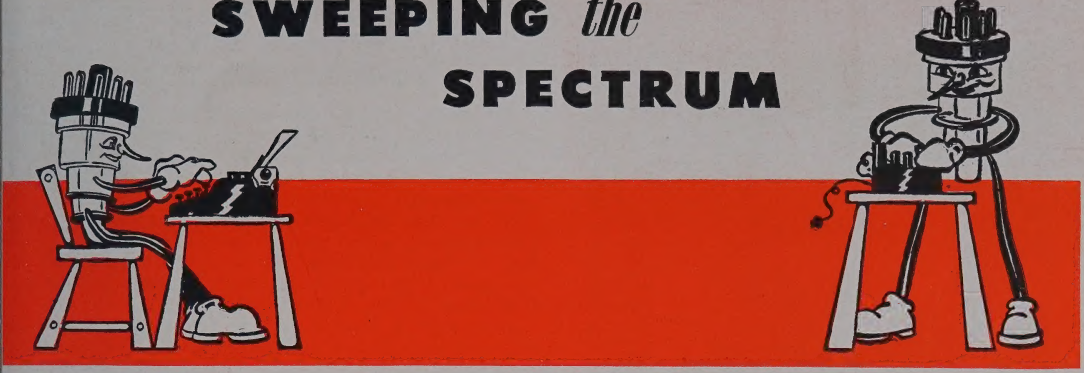
OILING MAST PULLEYS

Put about a foot of the antenna rope or cable in pan of oil for a minute or so—then quickly pull the rop up through the pulley and see-saw the oiled sectio around the pulley until you see the oil splashing ou

MICHAEL ROGERS

How did you solve that last problem that almost you stumped? Be it about tubes, antennas, circuits, Lighthouse Larry would like to tell the rest of the h about it. Send it in! For each "trick" published you $10 worth of G-E Electronic Tubes. Mark your le "Entry for Tricks and Topics" and send to Lighthouse La Tube Department, Bldg. 267, General Electric Compa Schenectady, New York, or in Canada to Canadian Gen Electric Company, Ltd., Toronto, Ontario. The Compa shall have the right, without obligation beyond above, to publish and use any material submitted this column. No entries returned.

SWEEPING *the* SPECTRUM



am radio is growing by leaps and bounds. Chair- Paul A. Walker of the Federal Communications mmission reports that licenses now number about 000.

his means an increase of more than 40% since the s immediately following World War II. Such swift vth is a sobering fact. Let's pull switches and think ut this a few minutes.

is a fact that participation in rule-making—ing our wants and needs known to the FCC—is mportant a part of ham radio as calling CQ or ding a VFO.

'e hear much talk these days that citizenship as a l, living force has been on the downgrade—that enship too often is taken for granted. The per-age of qualified voters who actually cast ballots in recent years, at least until the last election, been racefully low.

et's not complacently take the existence of ham o for granted. Our frequencies are valuable—and have them because we are deemed important to ization.

hairman Walker put it this way in his remarks at presentation of the 1952 Edison Radio Amateur ird in Washington recently:

Almost every day amateurs are called upon to pro- emergency communication . . . They are active ne military and civilian defense effort . . . They talk ne another around the world . . . Their techniques ribute to the advancement of the art and of the istry . . . They are an important factor in making better international good will and understanding They have the best wishes and the blessing of the eral Communications Commission."

weet music, yes. But it is up to us to continue to ify such praise.

* * *

ome of the fellows complain that one must be a yer to keep up with proposed rule changes these s. The point is well taken. New rules have been ing fast and furious over the past few years. We'd er a couple of kilowatts to a milliwatt that you ld count on your fingers and toes the number of and K's who right now could rattle off correctly precise frequencies on which they are allowed to rate.

ut that is the price we pay for civilization. As ety and science become ever more complicated, so st the average human brain speed up—lest the vidual be left by the wayside. Crying for a return he "good old days" is no solution; for history shows t "good old days" never return.

Ham organizations—from national associations to local clubs—have an increasingly important job these days. They can and must intensify their efforts to help members keep informed of rules and regulations—new and proposed. Of course, most clubs do this as a matter of course. But in many clubs a little revitalization of such activity would be a big help—perhaps by setting up special committees to analyze and report on new rules and regulations—instead of leaving the job to already-overburdened club secretaries.

What say, club officials? Got any good ideas on the subject? If so, we'll try to pass them along.

* * *

The individual ham has an even more important job. The FCC wants to hear from you—wants to hear what you think of proposed regulations, wants to get your suggestions on how to best use the ham bands. Don't think your voice is like a cry in the wilderness. For public officials pay considerable attention to individuals—especially when they hear from a lot of individuals.

And right now is a good time to speak your piece. For we are in a period of transition from the old Class A, B, and C system to a new order encompassing classifications for Novices and Technicians as well as General and Extra grade hams.

Just what the FCC is aiming for remains somewhat of a mystery at this writing. The present Amateur Extra Class license now carries no special privileges. And many hams say: "Why slave for a college degree if it won't get you above the ditch-digging level?"

The question is pertinent, but perhaps a little shortsighted. We think it is reasonable to assume that eventually Amateur Extra ticket holders *will* get some special privileges. Thus, working for that "college degree" now may pay dividends in the future.

* * *

The important point, however, is that every ham simply must put down his soldering iron and grid dip meter once in a while and write to the FCC—making known his thoughts on proposed regulations, preferably even before they are proposed.

Final rules never satisfy everyone. But the suggestions from all of us *must* get to the FCC members if rules and regulations are to represent majority interests. This democratic process takes time and effort by all of us. But it's our way of life.

Here's the address: Federal Communications Commission, Washington 25, D. C.

1952 Edison Award Winner

DON MULLICAN, W5PHP

Operating almost continuously for five days, Don served as the sole link between rescue HQ in Searcy and devastated Judsonia in the Arkansas tornadoes of last March. Traffic to and from the nation was funnelled through his ARC-5 on 75 meters.

At the left he shows how he used a haywire telephone nailed to the wall to link his station to rescue HQ. Don was nominated for the award by W5DVI who operated an emergency station at Judsonia with a crew that relied on the W5PHP link.

Don is 20, a bible student at Harding College—and you may hear him as a ZS or OQ in another year or so because he plans to become a missionary. He received a trophy, a wrist watch and a trip to Washington and New York City.

Special citations went to:

W1DBM—TVI research and development.
W6JJU—Outstanding traffic handling to servicemen overseas.
W8FYW—Developing radio course for the blind.
W9NZZ—Handling traffic to Arctic weathermen.

The 1952 Edison Radio Amateur Award was sponsored by the G.E. Tube Department. Judges were: G. L. Dosland, ARRL president; G.E. Sterling, FFC commissioner; and E. R. Harriman, Red Cross president.

Electronic
TUBE

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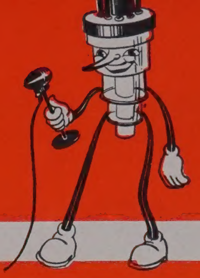
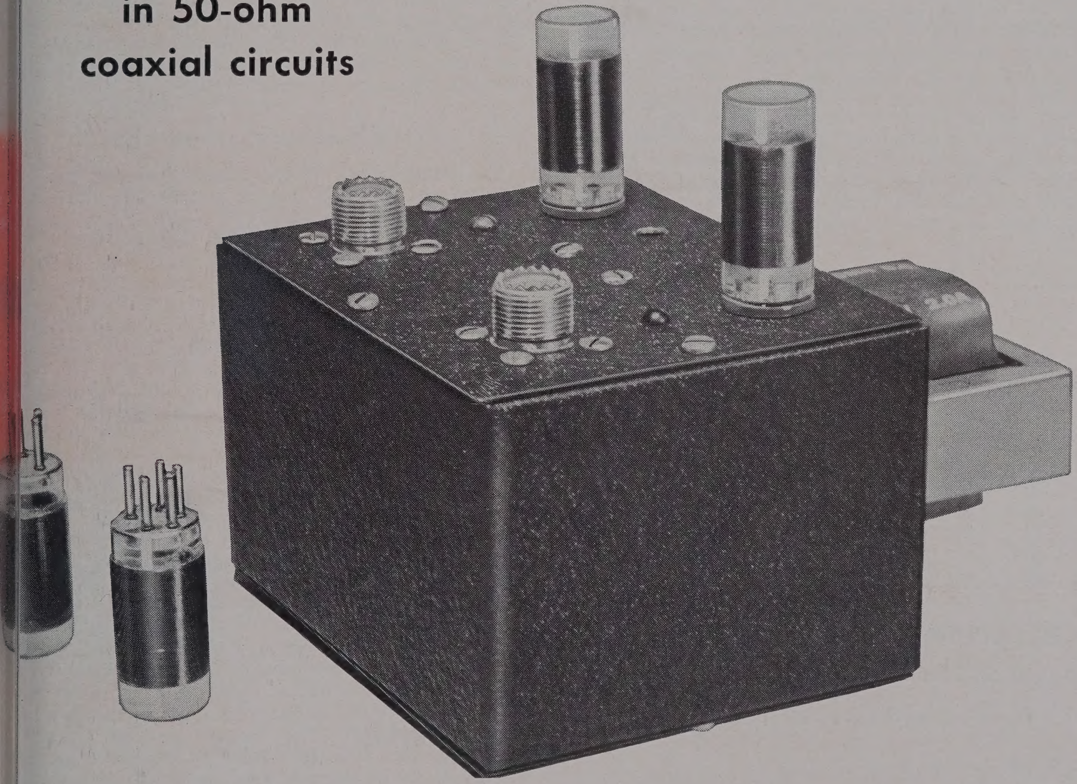


The DIOPLEX

. . . replaces
the antenna relay
in 50-ohm
coaxial circuits



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THE DIOPLEX

Here's the answer to the prayers of many a ham—an electronic circuit without switches or relays that permits a receiver to remain permanently connected to a transmitting antenna without damage to the receiver when the station transmitter is turned on.

The Dioplex taps into the transmission line and permits low-level incoming signals to pass into the receiver. However, when the transmitter is operating, the relatively high level signal voltage which appears on the line activates the Dioplex in such a way that the path to the receiver is blocked. Two words of caution at the outset: The unit is designed for 50-ohm coax; and as the operating frequency increases, the power-handling capacity of the Dioplex rapidly drops off. Of course, 80-meter boys are limited to 5000 watts!

—Lighthouse Larry

The Dioplex is a device for connecting a receiver to a transmitting antenna to obtain the advantage of as good an antenna for receiving as for transmitting. This is accomplished without moving parts—no relays with their clatter and possible erratic contacts to cause unexpected trouble. Since the action of the Dioplex not only is silent but instantaneous and positive, the receiver input circuits are afforded an even higher degree of protection from accidental or inadvertent damage than when a separate receiving antenna is used.

The Dioplex is used between a low impedance transmission line and the receiver as shown in Figure 1. With input and output impedances of 50 ohms, it is capable of protecting the receiver in accordance with the data in Table II. These figures are RF output—not d-c input. In most cases the allowable d-c input to the transmitter will be slightly higher. How much

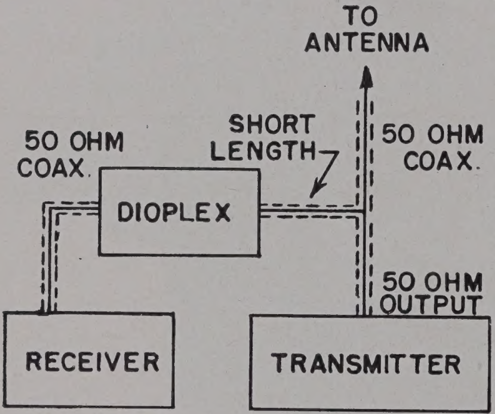


Fig. 1—How the Dioplex is connected

higher will depend, of course, on the efficiency of
final stage of the transmitter.

It is fortunate that at low frequencies where
receiving insertion loss is greatest, the practical e
on the received signal, though measurable, is
negligible. It is unfortunate, however, that the
tinuous power rating drops so rapidly with increa
frequency, and that the transmitting insertion
while constant, becomes a greater percentage of
permissible transmitter output.

CIRCUIT DETAILS

The complete circuit diagram for the Diople
shown in Figure 2. The input goes from a coa
connector to a plug-in coil. Two biased 6X4 di
operated back-to-back serve as a voltage-sensi
shunting element. Also, half of one of these tube
used as a 60-cycle half-wave rectifier to provide d
bias from the transformer. The two selenium recti
serve merely as bias voltage stabilizers. The bias
be from 2 to 2.5 volts on each diode. A 3–30 mi
microfarad mica trimmer is used to compensate
variations in the internal tube capacities plus str
Those interested in a more detailed description of
operation of the Dioplex are referred to the sec
headed "Thumbnail Theory."

CONSTRUCTION DETAILS

All components of the Dioplex except the tr
former are mounted on one of the removable 4
inch plates of a Bud 3 x 4 x 5-inch utility box.
tube sockets are mounted on an L-shaped bracket
can be simply made of $\frac{1}{16}$-inch aluminum. Before
coil sockets and coaxial connectors are mounted,
paint should be scraped from the plate to assure
grounding. If sockets with built-in by-pass conden
are used (as in the model shown), the by-pass st
should be removed from pin 1 of V_1 and from p
of V_2, since these points operate at RF potential. V
ordinary sockets, ceramic by-pass condensers sh
be installed as close to the socket terminals as poss

The transformer is mounted in the center of on
the 3 x 5-inch sides of the utility box with the leads f
the secondary windings brought inside through a
ber grommet. The primary leads are left free
connection to the 110-volt a-c line. No switch is
vided, since accidental damage to the Dioplex
possibly to the receiver can occur if the 6X4 tubes
not energized when transmitting.

Although wiring is not critical, a piece of tin
No. 14 wire is arched between the coil sockets. Kee
this lead in the clear reduces stray capacity and
vides an easy method of connecting the plate of
the cathode of V_2, and the "stator" of the mica c
pression trimmer. The "rotor" of the trimme
bolted to the L-bracket next to the tube socke
shown so as to provide easy access to the adjus
screw through a $\frac{1}{4}$-inch hole drilled in the top p
Tinned No. 14 wire also is used to ground the un
pins on the coil sockets, thus providing a measur

ding.* Insulated wire is used for the other con- ons.

he high voltage and filament leads from the trans- er—connected last—are left their original length looped around inside the box after the top plate tached. This makes it easy to remove the top plate ld occasion rise.

COIL DATA

l coils are wound on Amphenol polystyrene 5- oil forms $\frac{3}{4}$ inch in diameter and $1\frac{5}{8}$ inches long. identical coils are required for each band. Winding is given in Table I. Since none of the windings ore than 1 inch long, the bottom turns can start ch from the base of the forms. In each case, the bottom of the coil winding should connect with pin 3 of the plug-in form and the top of the winding with pin 1—thus providing the widest possible separation at the coil socket. If the winding information is followed closely, it should not be necessary to reset the trimmer condenser when changing bands. The turns should be sealed on the forms with Duco or G-E Glyptal No. 1286 cement. The end turns on each coil should be cemented all the way around the form, and then four strips of cement can be run lengthwise at 90-degree intervals to hold the entire winding in place.

Since polystyrene melts at a relatively low temperature, caution is advised in soldering the coil ends to the pins. The inside of each pin to be soldered should be reamed clean with a drill and a hot iron used just long enough to flow the solder into the pin tips.

GENERAL INFORMATION

It is necessary to assure that a d-c circuit path is

---

ne eagle-eyed readers may notice that six-hole sockets are d in the model illustrated. This is because they were at nd when this unit was built. The Amphenol 24-5H plug-in ms fit in the six-hole sockets made for the 24-6H coil forms.

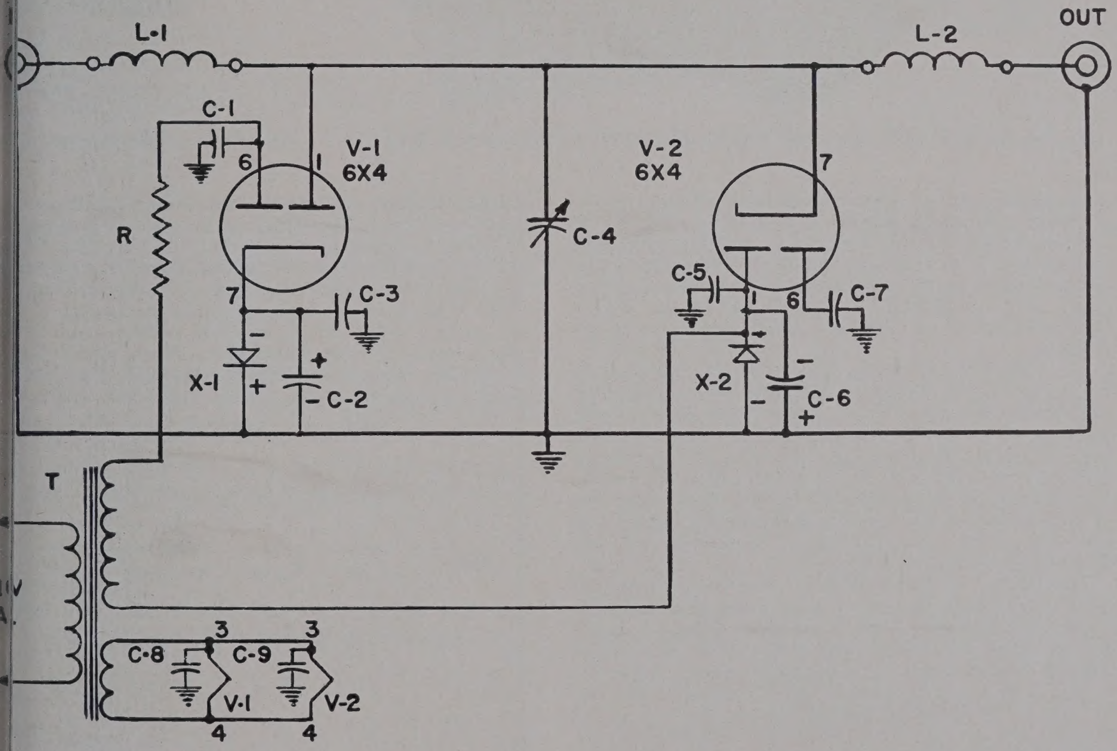


Fig. 2—Circuit diagram of the Dioplex

C_3, C_5, C_7, C_8, C_9—.001 mfd ceramic bypass
C_6—50 mfd. 50-volt electrolytic
-3-30 mmf mica compression trimmer
L_2—(See text and Table I)

R—33,000 ohms, 1 watt
X_1, X_2—100 ma, 380-volt selenium rectifier (GE-5GH1)
T—Power transformer: Pri. 117 V 60 cy; sec. 117 V $\frac{1}{2}$ wave @ 50 ma d-c, 6.3 V @ 2 A (Stancor PA8421)

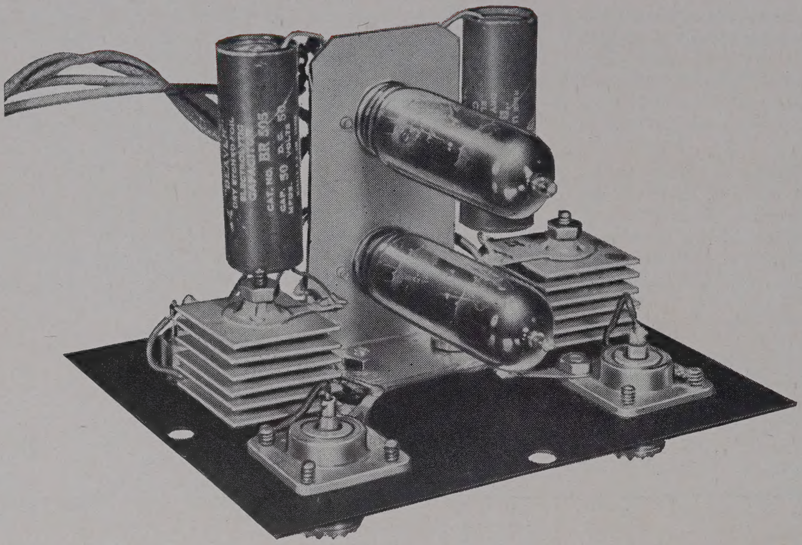


Fig. 3—The 6X4 diodes are mounted on a simple L-bracket

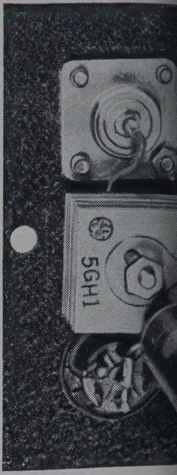


Fig. 4—Components of

maintained between the coils and the chassis of the Dioplex. Ordinarily, the input coil of the receiver or the output link of the transmitter provides this path through the coax braid. In doubtful cases, this can be checked with an ohmmeter and if no d-c connection exists, a 2.5 millihenry pie-wound RF choke should be placed across one of the coaxial connectors of the Dioplex.

Since the Dioplex design is based on 50-ohm receiver input impedance, deviation from this value will affect principally the amount of power dissipated in the receiver when the transmitter is operating. If there is doubt about the input impedance of the receiver, a 51-ohm 1-watt resistor may be placed across the output connector of the Dioplex to assure that the combination of this artificial load and receiver never exceeds 50 ohms. In most cases, this shunting resistor will not degrade receiver performance.

The power ratings in Table I apply only when the input to the Dioplex—that is, the side that connects to the transmission line—is across a 50-ohm circuit. Simply using 50-ohm coaxial transmission line is not enough to assure that this condition exists unless the standing wave ratio on the transmission line is close to unity. The important consideration here, as far as the Dioplex is concerned, is that the RF voltage applied by the transmitter must not exceed 500 volts at 3.5 mc, 250 volts at 7 mc, 125 volts at 14 mc, 80 volts at 21 mc, and 56 volts at 28 mc. Keeping within these ratings will prevent a receiver from being burned out due to tube failure caused by overload.

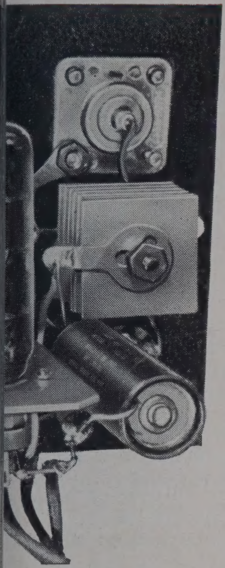
The effect of a transmitter connection across the receiver input can be troublesome if the transmitter output stage is not biased beyond cutoff during rec
tion. And with the Dioplex in place, the coupl
between transmitter output stage and receiver is v
good indeed for low-level extraneous signals someti
generated in a transmitter that normally is conside
"off." Operators of single-sideband stations know t
an active output stage coupled to the antenna
cause local receiving difficulties. These difficulties
be greatly magnified with the Dioplex. Blocked-

TABLE I—COIL DATA

All coils wound with enamel or Formex insulat
wire on ¾-inch plug-in forms (Amphenol 24-5H).

Band	Wire Size	No. of Turns	Length of Winding	Inductan (milli- henries)
3.5	#32	110*	1 in.	0.125
7	#26	57*	1 in.	0.035
14	#19	29*	1 in.	0.00875
21	#19	20**	1 in.	0.004
28	#19	13**	¾ in.	0.0022

* Close-wound. ** Spaced.



n space-saving arrangement

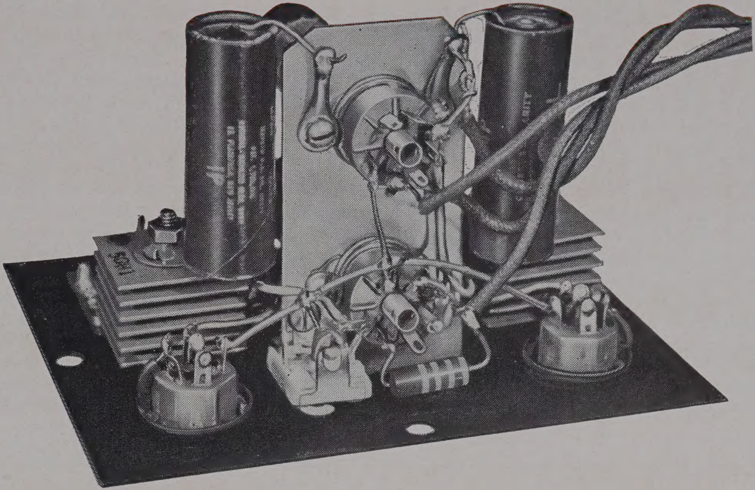


Fig. 5—Tinned No. 14 wire arches over V_1 to connect the two coil sockets

V keying circuits or sufficient protective fixed bias the output stage of the transmitter should prevent h troubles.

Note the polarities of the electrolytics and selenium tifiers in the schematic. The cathode of V_1 should be sitive with respect to ground, while plate 1 of V_2 ould be negative with respect to ground. Thus the larities indicated on the electrolytic condensers are rrect. The selenium rectifiers are connected "back- rds" to provide a stiff diode bias source without ing much standby power. The GE-5GH1 rectifiers e marked with a red dot on one pole which in this se is connected where the plus signs are marked in e schematic. The d-c voltage across the electrolytic ndensers should be checked before using the Dioplex make certain only about 2 or 3 volts bias appears en the tubes warm up. Much more bias than this dicates either that the selenium rectifier connections ould be reversed, or the rectifier is defective.

While in most applications the bias provided will ample to prevent diode conduction during reception, ceptionally strong incoming signals reaching the ioplex can cause cross-modulation. If this problem is countered, two selenium rectifiers can be wired in ries where one now is called for in the schematic. he bias then should be from 4 to 6 volts d-c on each X4 tube.

One final but important bit of advice. The trans- itter never should be operated without the 6X4 bes in place and the Dioplex energized. The primary the Dioplex transformer can be connected in parallel ith the primary of the filament transformer for e transmitter's output tube or tubes—thus assuring that a major part of the transmitter output will not be dumped into the receiver. Always use the coils for the band on which the transmitter is operating.

INSTALLATION AND OPERATION

As indicated in Figure 1, the lead from the transmission line to the Dioplex should be as short as practical. This connection can be made with one of the coaxial T-connectors, or the Dioplex input can be connected directly on the transmitter output terminals if that method is more convenient. The cable from Dioplex to receiver can be any convenient length. With the transmitter off, the proper Dioplex coils in place and the 6X4 filaments warmed for at least 30 seconds, the mica trimmer should be adjusted for best received signal strength near the high portion of the band. The same adjustment should hold for all bands. The Dioplex can, of course, be peaked for a favorite frequency.

Never attempt to run more than 5000 watts output on CW, AM or NBFM or 10,000 watts peak output on SSB on 80 meters! Similarly, keep within the ratings of Table II on other bands.

THUMBNAIL THEORY

The Dioplex is based on the principle of radar's "T-R box," using lumped circuit constants instead of the transmission lines or waveguides common in radar techniques. A better description might be that the Dioplex is electrically a half-wave filter similar to the Harmoniker (G-E HAM NEWS, Vol. 4, No. 6, Nov.-Dec. 1949). But while best operation of the Harmoniker requires a reasonable impedance match, the Dioplex accomplishes its purpose by means of deliberate mismatch. In fact, the greater the degree of mismatch in this application, the better protection to the receiver.

A half-wave filter such as the Harmoniker effectively is "not in" a circuit of any impedance at the half-wave frequency. In describing the Harmoniker, a curve was given showing how the voltage on the center condenser varied with mismatch. The Dioplex takes advantage of this phenomenon so that a relatively light-duty short-circuiting device across the center condenser can thwart the efforts of a kilowatt rig to get into the receiver through the antenna terminals.

By placing biased diodes back-to-back across the center condenser of the half-wave structure, small signals do not cause conduction in the diodes—and the receiver is connected to the antenna feedline through the half-wave filter. However, when a signal from the transmitter appears across the input to the filter, the diodes become conducting and the receiver is substantially (but not entirely) isolated from the input. At the center condenser, the transmission line voltage is magnified by a factor approximately equal to the ratio of the reactance of one of the coils to the resistan of the load until conduction commences in the diode At this voltage, and at any higher input voltage, tl magnification ceases and a current flows through tl input coil into the diodes which have a net forwa resistance of about 400 ohms.

Thus the device becomes a voltage divider of tw stages—the first stage being the reactance of the inpu coil and the diode forward resistance, while the secon stage consists of the reactance of the second coil an the input impedance of the receiver. Simply state then, the design objectives are: (1) As high a co reactance as practical, (2) as low a diode forwa resistance as possible, and (3) a relatively low loa impedance.

These objectives place certain restrictions on tl application of the Dioplex, and in effect limit i practical realization to low-impedance receiver input- from 50 to 300 ohms or so—and to operation in a lo impedance point in the transmission line feeding tl transmitter output to the antenna. This system worl out nicely for 50-ohm coaxial circuits, and the desig given for the Dioplex is for this application.

TABLE II—PERFORMANCE DATA

Band	Transmitter Output (watts)		Voltage at Receiver*	RF Input to Receiver* (watts)	Insertion Loss*	
	Cont. (Col. 1)	Peak (Col. 2)	(Col. 3)	(Col. 4)	Rec'g (Col. 5)	Xmt'g (watts) (Col. 6)
3.5	5000	10000	1.25	.03	6 DB	10
7	1150	10000	2.2	.1	3 DB	10
14	290	4500	4.5	.4	. .**	10
21	130	2000	6.4	.85	. .**	10
28	64	1000	8.5	1.45	. .**	10

NOTES

Col. 1—Determined by the safe continuous diode current.

Col. 2—Based on maximum safe input voltage, or an average duty cycle of one-quarter (whichever is lower) in the case of single- sideband suppressed carrier operation.

Cols. 3 & 4—Based on continuous CW, AM or NBFM output delivered to a 50-ohm receiver input. The RF power actually delivered to the receiver (Col. 4) will vary in direct proportion with the continuous transmitter output (Col. 1) in each band—*i.e.*, 145 watts continuous output at 14 mc. would deliver .2 watt to receiver.

Col. 5—Based on a coil Q of 100. Coils in unit described have a Q of about 150, so this rating is conservative.

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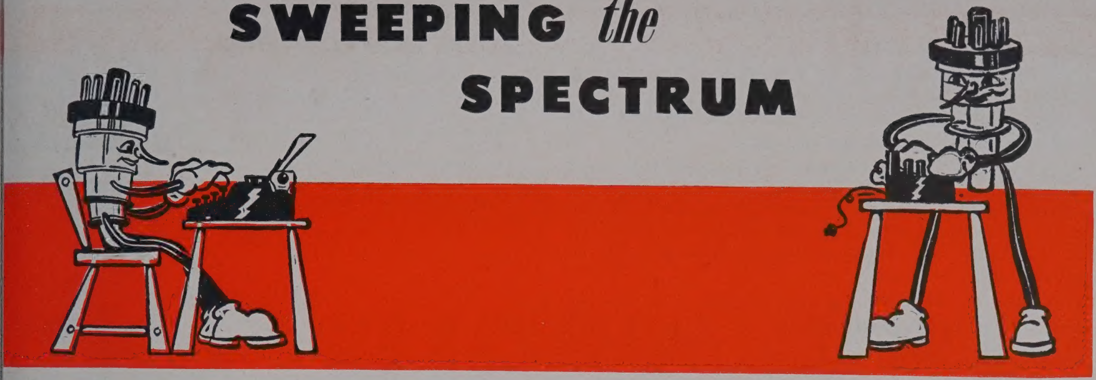
* Approximate.

**Negligible.

SWEEPING *the* SPECTRUM



The other day the editor came back from lunch nd upon noting my wrinkled brow and painful "hunt nd peck" typing system, he wondered out loud:

"Why should a guy with an electron stream instead a brain be tied to a typewriter?"

I held my breath and he went on:

"Larry, go on over to the lab and start building mething."

"Can't right now," I said. "I've got to write copy r G-E HAM NEWS, read the proof, get pictures ken, arrange for drawings, and—"

"Look, Larry," he said, "I'll do the dull editorial utine. As soon as you finish the column, go plug ourself in and start cooking up something. Concentrate stepping up your electron stream."

At that I almost popped a filament. It was the best ews of the year for me. And soon as I finish here, I'll heading for the lab.

* * *

The XEs down Mexico way, all het up about their st national convention, have been good enough to nd a few pictures—including a glamor shot of a etty, pretty named Alma Velasco, who has been ubbed "Queen of the Hams." The Queen will reign at uadalajara May 26 through 30. We asked the boss if e ought to run the Queen's picture in G-E HAM EWS. "No," he said, "the boys are more interested in cillation than osculation." We pointed out that some the boys might start oscillating if we ran the picture. ut he insisted we need every bit of space for technical ope. So we gently tucked the Queen's picture away the file.

Some of the items on the program look fascinating. fter the opening of XE1N, president of LMRE, we nd, for instance: *Planes a Desarrolar Para la Con-truccion del Edifico de la LMRE* (Ah, new building r the boys); *Defensa de la Patria* (So they have CD o!); *Como se Estudia la Atmosfera con los Globos de adiosondeo* (How's that again?); *Conferencia Sobre lectronica por un Tecnico de la General Electric* Good, very good!); *El Porvenir y Desarrollo de la elevision* (Oh, oh! Trouble south of the border!).

The boss just poked his head in and said: "Good luck all the XEs."

* * *

Speaking of national conventions, a bulletin on the 7th National ARRL Convention (Houston, Texas, July 10 through 12) has arrived. It says there are 4230 hotel rooms and motel units in town, and hams who start filling them up early will have a shot at a complete ham station as a pre-registration prize. The program includes VHF, UHF, CD, TV, TVI, ROWH (??), DX, TT, SSB, TFC, EC—and undoubtedly a little XXX in the evenings.

* * *

The boys have been writing like crazy asking for the suggested article on how to determine the noise figure of a receiver. I'm hard at work on it with W2RDL and will pass on the dope as soon as possible . . . Another thing we're working out, with W2KUJ, is a voice control break-in system for SSB . . . By the way, we'd like to hear of experiences with the Dioplex W2KUJ cooked up for this issue . . . and also from those who tried the W2FZW's Mobile/Portable Power Supply and W2KLM's Antenna Loading Coil, both of which were described in the last issue of G-E HAM NEWS . . . We're working with W2RMA on converters for 440 and 220 megacycles . . . and with W2GYV on a new final.

* * *

Just got a note from George Floyd, W2RYT, founding editor of G-E HAM NEWS. He wants to pass 73's to all. George is now working with G-E communications equipment in Syracuse and says he's getting along fine.

* * *

A plea from the hard-working utility and telephone linemen comes via the bulletin of the Detroit Amateur Radio Association, and we pass it along because it can save someone's life—maybe yours. DON'T HANG YOUR SKYWIRE ON A UTILITY OR TELEPHONE POLE!

Three good reasons: (1) Your shack will become an efficient electrocution chamber if wind tosses a conductor of some sort across your wire and the high voltage lines; (2) your RF may light up every circuit on a local LL switchboard; and (3) a lineman may be killed if he trips on your wire while climbing the pole some dark night to restore your phone or power service.

—Lighthouse Larry

Technical Information ★ ★ ★ ★ ★ 600

THE RUGGEDIZED 6AQ5

The GL-6005 is one of G.E.'s line of 5-Star high reliability tubes which are specially designed to assure dependable life and reliable service under the exacting conditions encountered in mobile work.

Features include mechanical ruggedization and heater-cathode construction designed to withstand many-thousand cycles of intermittent operation. Electrical characteristics and pin connections are identical with the 6AQ5—the beam power pentode popular in small rigs and receivers.

The tube is described here merely as a matter of general information, inasmuch as few hams require such exacting performance. However, those interested can get full details from bulletin ETX-265.

SPECIAL CHARACTERISTICS

Peak Impact Acceleration in Any Direction* . . 600
Vibrational Acceleration in Any Direction† . . 2.5

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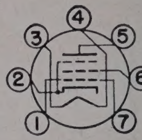
* Forces in any direction as applied by the Navy Type H Impact (flyweight) Shock Machine for Electronic Devi or its equivalent.

† Vibrational forces in any direction for a period exceed 100 hours at a frequency of 60 cps.



TYPICAL OPERATION

CLASS A$_1$ AMPLIFIER

Plate Voltage	180	250 Volts
Screen Voltage	180	250 Volts
Grid Number 1 Voltage	−8.5	−12.5 Volts
Peak A-F Grid #1 Voltage	8.5	12.5 Volts
Plate Resistance (Approx)	58000	52000 Ohms
Transconductance	3700	4100 Mho
Zero-Signal Plate Current	29	45 Ma
Maximum-Signal Plate Current	30	47 Ma
Zero-Signal Screen Current	3	4.5 Ma
Maximum-Signal Screen Current	4	7 Ma
Load Resistance	5500	5000 Ohms
Harmonic Distortion (Approx)	8	8 %
Power Output	2.0	4.5 Watts

CLASS AB$_1$ (VALUES FOR TWO TUBES)

Plate Voltage	250 Volt
Screen Voltage	250 Volt
Grid Number 1 Voltage	−15 Volt
Peak A-F Grid-to-Grid Voltage	30 Volt
Plate Resistance (Each Tube)	60000 Ohm
Transconductance (Each Tube)	3750 Mho
Zero-Signal Plate Current	70 Ma
Maximum-Signal Plate Current	79 Ma
Zero-Signal Screen Current	5 Ma
Maximum-Signal Screen Current	13 Ma
Effective Load Resistance (P-to-P)	10000 Ohm
Total Harmonic Distortion	5 %
Maximum-Signal Power Output	10 Watt

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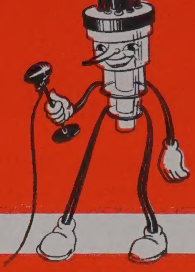
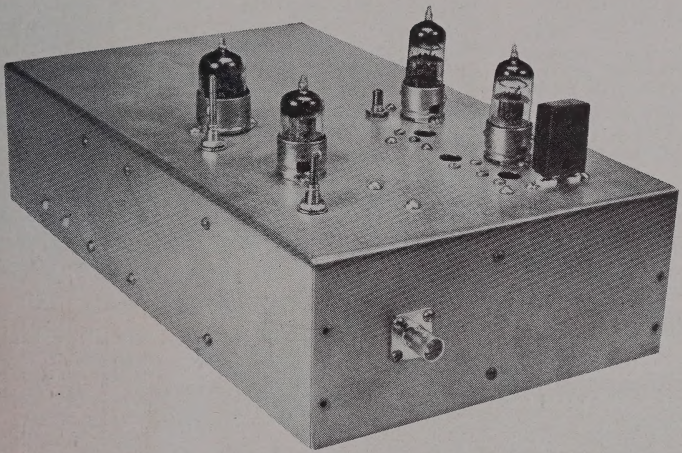
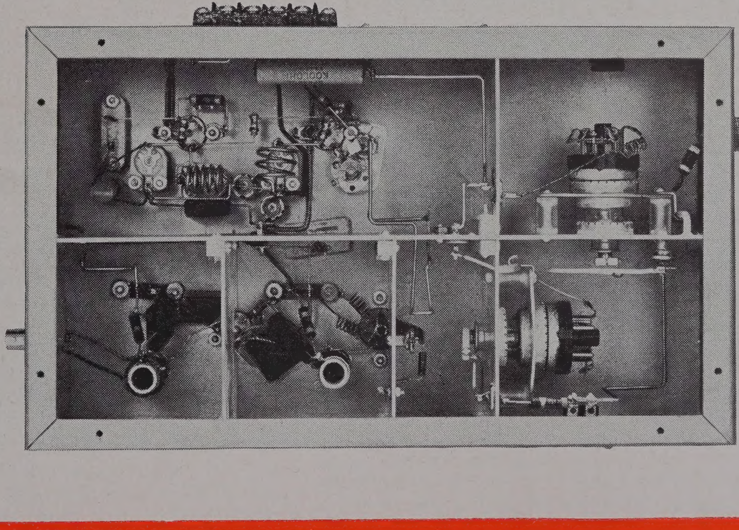


The SUPER 430

a 6-Tube Converter for Top Performance





ontents

The Super 430 .... page 2
Sweeping the Spectrum .... page 7
Rat Trap Pulse Generator .... page 8

THE SUPER 430

Sometimes we take pride in putting together in an hour or so some neat little gadget which, considering its simplicity, does its job amazingly well.

Other times we take our pride in slowly building a piece of equipment which will deliver unquestionably superior performance. Such is the Super 430 Converter. It requires some care in mechanical construction, but the effort pays off handsomely in the stability needed to hold a narrow AM signal in the 420–450 mc band.

—*Lighthouse Larry*

Superior reception is no harder to achieve in the 420–450 mc band than it is on the lower frequencies. However, while on the lower frequencies just any old tube often is good enough, hams find their choice ever more limited as they climb higher on the frequency spectrum. At 420 mc and above the lighthouse tube stands as one of the few "bottles" that will give first-rate, dependable performance.

The Super 430 converts signals in the range of 432 to 435 mc—representing the third harmonic of most 2-meter transmitters—to intermediate frequencies between 10 and 13 mc. It is a crystal-controlled converter, and tuning is done with the communications receiver in the i-f range.

The crystal-controlled oscillator was chosen after much experimentation showed that self-excited local oscillators, even those working from a third or half of the operating frequency, generally are not stable enou to hold a narrow band AM signal—to say nothing o CW signal—at 432 mc. The Super 430 primarily meant to receive signals from stabilized or cryst controlled transmitters. Amateurs who have operat in the VHF and UHF ranges know how well a lo power stabilized narrow band signal outperforms s nals of many times the power spread over seve megacycles.

Hams picked up lighthouse tubes by the dozens the surplus market a few years back, yet few of th high-frequency tubes have appeared in published h radio circuits. The reason apparently is that fraternity has shied away from constructing the nec sary special socket. Actually, however, building t socket requires no more mechanical effort or ingenu than hams display daily all over the world in devis new ways to put together complicated superbloop and wave-busting finals on the lower frequencies.

The Super 430 Converter can be built with hacks file and hand drill and will be as stable as the proverb rock. The Super 430 uses two 2C40 lighthouse tubes grounded grid r-f amplifiers, a pair of 6J6's to brin 7-mc crystal oscillator up to the band, a 6AM4 grounc grid mixer, and a 6AK5 broad-banded i-f amplifier. 12 x 7 x 3-inch chassis is divided into compartme as shown in Figure 1. In this picture the crystal osci tor and the 6J6 multipliers are in the large compa ment at the upper left. The input connector and fi r-f stage are at the upper right, and the second

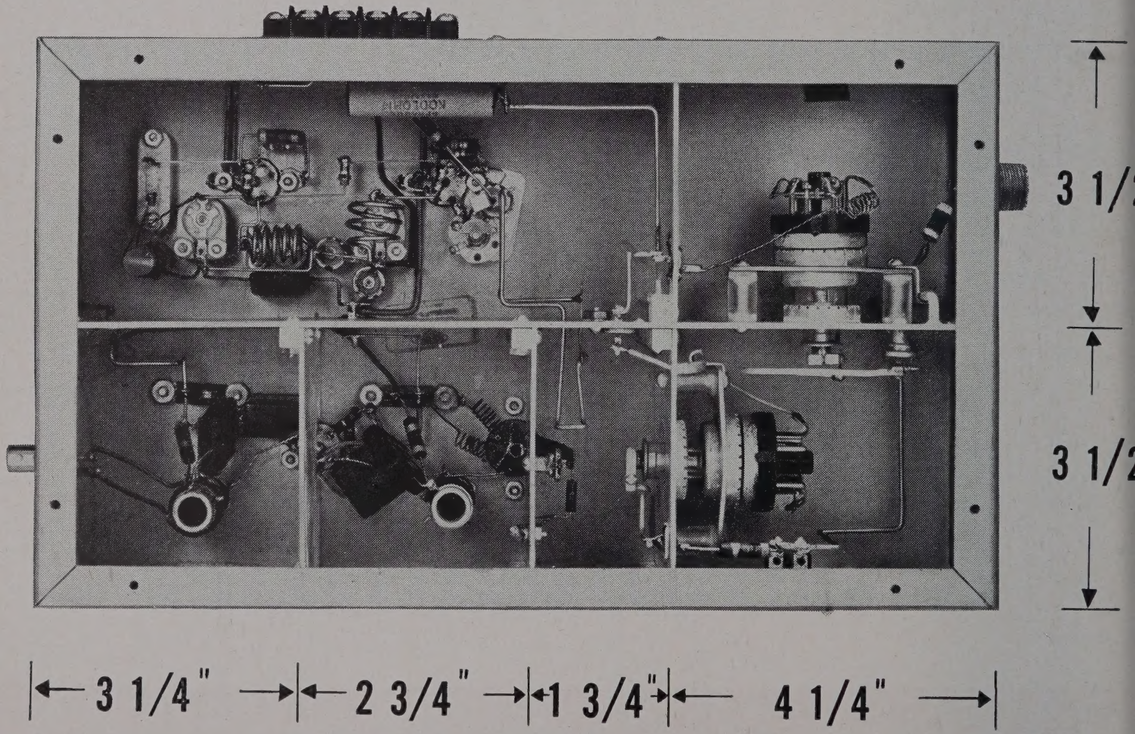
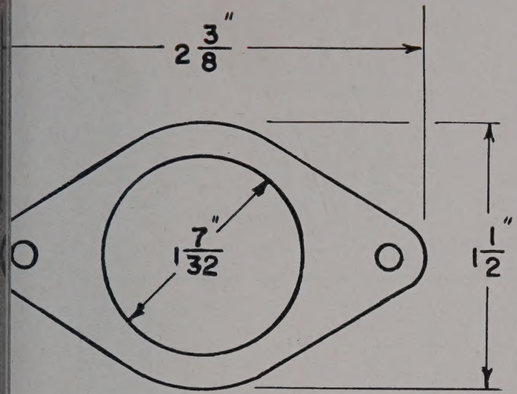


Fig. 1—The two r-f compartments and "mixing chamber" should be the same size as shown. Sizes of other cor partments not critical



2—*Outline of brackets that hold cathode spring k for the shell connections to the lighthouse tubes*

e is in the lower right corner. Next comes a mixing nber where the plate tank loop of the second r-f e, the link from the oscillator, and the cathode uit of the 6AM4 mixer are brought into proximity. next compartment to the left contains the remain- of the 6AM4 stage, and at the lower left corner is 6AK5 i-f amplifier and the output connector. The partments are made of $\frac{1}{16}$-inch brass stock. The lus voltage should be between 150 and 180, and need be regulated.

THE R-F AMPLIFIERS

or maximum performance, two stages of 2C40 r-f plification are used, and the mountings for these es comprise the only unusual—though not difficult— chanical construction.

'he coaxial antenna input connector feeds through 5-mmf condenser to the junction of the cathode line the bracket which holds the cathode ring of the e. This spot is found experimentally, when testing converter, by moving the junction point up and vn on the line for best performance.

'he cathode and grid connectors are made from ing finger stock which is a standard part made by Instrument Specialties Corporation.* They may be ained ready-curled and are soldered to the inside es of holes made in the plates as shown in the illus- tions.

)ne-inch holes in the compartment shields accom- date the spring mounts for the grid rings of the es, and 1$\frac{7}{32}$-inch holes in the cathode brackets take springs for the cathode rings. The cathode brackets gure 2) are set off from the compartment shields by cers ⅝ of an inch long made of ⅜-inch polystyrene . However, suitable ⅝-inch long ceramic spacers eady tapped can be found in many pieces of surplus uipment.

n both r-f amplifiers, the cathode "coils" consist 1¾-inch lengths of ⅛-inch copper tubing bent as wn and spaced $\frac{5}{16}$ of an inch from the grid planes. ort strips of copper connect these "coils" to the hode brackets as shown. Since the r-f amplifiers are erated grounded grid, the input circuits are quite oad. However, if the circuit seems to tune too low, other similar length of tubing may be placed in parallel with the first to lower the inductance of the input circuit.

The ⅛-inch tubing permits a heater lead to be brought through to the second 2C40, while a button feed-through capacitor connects the heater lead with that of the first 2C40. The heater and cathode of the first r-f stage are kept above ground by the choke shown in Figures 3 and 7. An additional choke may be added between pin 2 and ground.

The pin connections are made by use of clips removed from an octal socket. The cathode biasing resistors are mounted on these clips as shown in the first r-f stage in Figure 3. A similar resistor, not visible in the photographs, is mounted on clips on the pins of the second r-f stage.

Since the 2C40 tubes are operated Class A and no high peak currents are required, considerable life will be added to the tube by operating at reduced filament voltage. This should be the lowest voltage at which performance and noise figure is not impaired—in most cases between 5.2 and 5.7 volts. With the filament supply used on the model shown this was accomplished by the large Koolohm resistor at the terminal strip. However, with 6.3-volt supplies, the dropping can be done with a resistance of from .5 to 1.0 ohms rated at 5 watts.

Plate connections on the model illustrated are made with clamps which were specially turned out for this converter. They are made from pieces of ⅛-inch brass, drilled with a ¼-inch hole for the tube cap, slotted, the corners filed round, and drilled and tapped to take a 4-40 machine screw for clamping. While the clamps shown were made with machine tools, simpler ones can be fashioned with hand tools—or available screw- or bolt-type clamps can be used. The objective here is to be able to secure the clamps firmly once the plate tank loops are in the proper position.

The tank loops are made of tinned No. 14 wire shaped to the approximate dimensions shown in Figure 5 and spaced from $\frac{5}{16}$ to ½ inch from the compartment shields to which the grid rings are grounded.

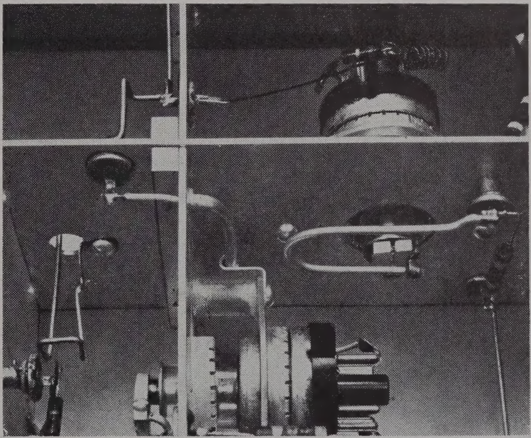
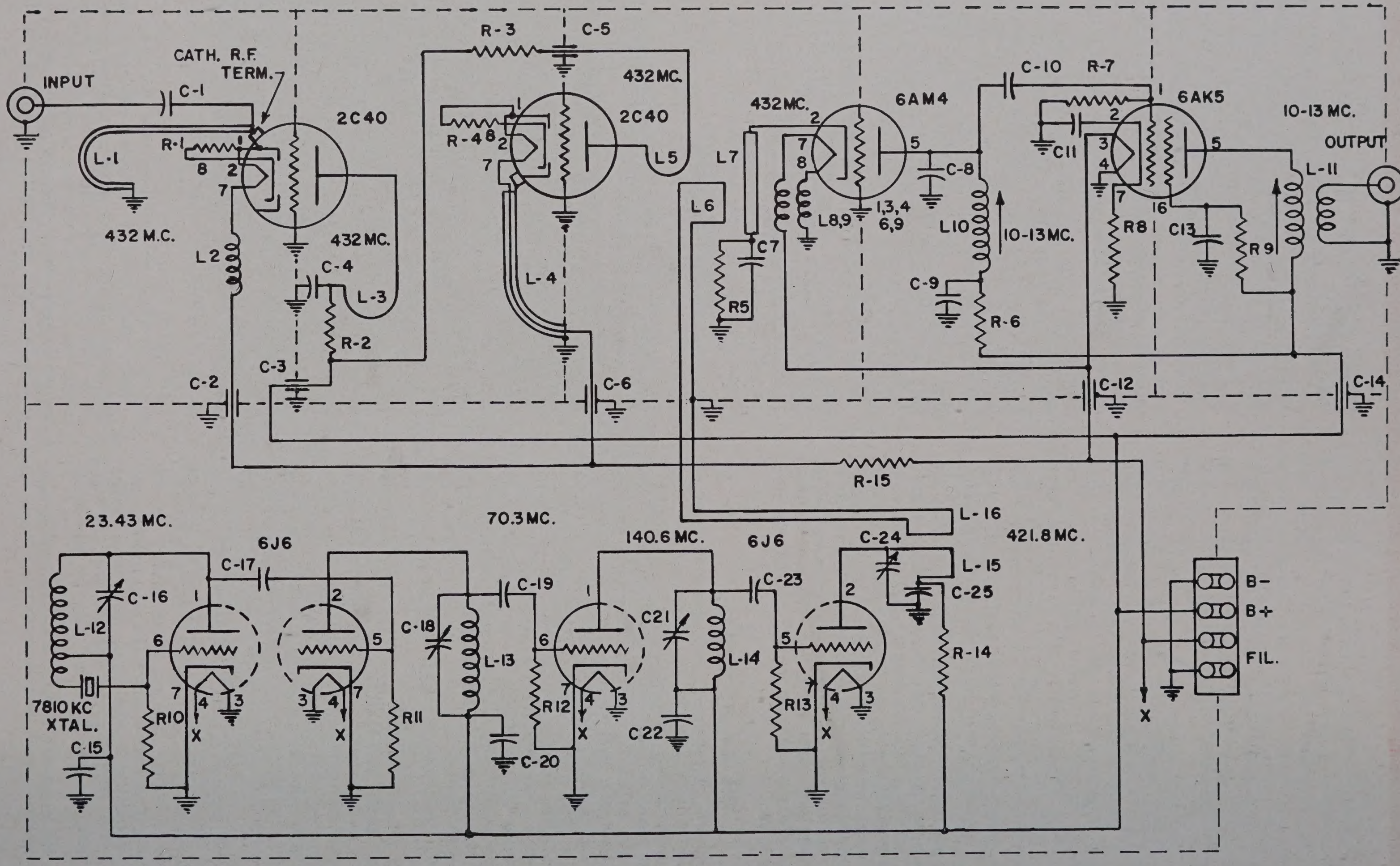


Fig. 3—Details of construction of the r-f stages

These plate lines are operated against ground (the grid planes of the tubes) and are bypassed at the "cold" ends with 500-mmf button condensers. Resistors de-couple the loops from the rest of the circuit. The tubes are set on range by moving the anode caps up or down on the cap, thus varying the impedance of the plate

---

*2 Bergen Boulevard, Little Falls, N.J. The cathode con- tor stock number is 97-70; the grid connector 97-72.


INPUT
CATH. R.F. TERM.
C-1
R-1
L-1
432 M.C.
L2
2C40
432 MC.
C-4
L-3
R-2
C-3
C-2
R-3
C-5
432 MC.
2C40
R-4
L5
L-4
C-6
L6
L7
C7
R5
432 MC.
6AM4
L8,9
1,3,4 6,9
C-8
L10
10-13 MC.
C-9
R-6
C-10
R-7
C11
6AK5
R8
C13
R9
L-11
10-13 MC.
OUTPUT
C-12
C-14
R-15
23.43 MC.
6J6
C-16
L-12
7810 KC XTAL.
C-15
R10
C-17
R11
70.3 MC.
C-18
C-19
L-13
C-20
R12
140.6 MC.
C21
L-14
C22
6J6
C-23
R13
C-24
L-16
L-15
C-25
R-14
421.8 MC.
B-
B+
FIL.
X

Circuit Diagram of the Super 430. All resistors half-watt except as otherwise noted.

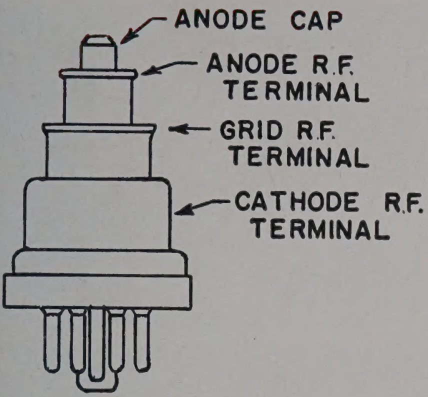


Fig. 4—Outline of the lighthouse tube

e. Coupling between first and second r-f stages is complished by the proximity of the first r-f amplifier's ate tank to the cathode line of the second r-f tube.

The high-voltage lead to these loops starts at the rrier-type terminal strip and runs along the chassis nd. It passes from the oscillator compartment to e first r-f compartment through a hole formed by pping the far corner of the shield separating these mpartments, and then is brought through the shield parating the two r-f compartments via a 100-mmf tton feed-through capacitor.

From here a decoupling resistor brings the high ltage to a 500-mmf ceramic button by-pass stand-off ndenser which acts as a terminal for the long leg of e plate tank loop of the first r-f stage. Another lead om the 100-mmf feed-through condenser continues around the base pins of the second r-f tube to a terinal lug.

COMPONENTS

C_1, C_{17}, C_{19}—25 mmf ceramic
C_2, C_3, C_6, C_{12}, C_{14}—100 mmf button feedthrough
C_4, C_7, C_{20}, C_{22}, C_{25}—500 mmf button standoff
C_5—500 mmf button feedthrough
C_8—5 mmf silver mica
C_9, C_{11}, C_{13}, C_{15}—.005 mfd mica or ceramic
C_{10}—500 mmf mica or ceramic
C_{16}, C_{18}, C_{21}—4–30 mmf trimmer (Erie TD2A-4)
C_{23}—10 mmf ceramic
C_{24}—1.5–5 mmf variable (Johnson No. 160–102)
L_1, L_4—cathode loop (see text and photographs)
L_2, L_8, L_9—RFC—6 t. No. 22 en. 3/16-inch d., 3/8-inch long
L_3, L_5—plate loops (see text and photographs)
L_6, L_{16}—oscillator injection link (see text and photographs)
L_7—mixer cathode coil (see text and photographs)
L_{10}—36 t. No. 22 en. close-wound on 1/2-inch d. slug-tuned form
L_{11}—same as L_{10} but with 6 t. link of insulated wire at cold end
L_{12}—30 t. No. 22 en. close-wound on 3/8-inch polystyrene form and tapped 10 t. from crystal end
L_{13}—5 t. No. 14 tinned, 3/8-inch i.d., 5/8-inch long
L_{14}—3 t. No. 14 tinned, 3/8-inch i.d., 3/8-inch long
L_{15}—U-shaped loop (see text and photographs)
R_1, R_4, R_8—180 ohms
R_2, R_3, R_6, R_{14}—1000 ohms
R_5—100 ohms
R_7—5100 ohms
R_9—2000 ohms, 1 watt
R_{10}—3000 ohms
R_{11}—50,000 ohms
R_{12}—22,000 ohms
R_{13}—15,000 ohms
R_{15}—(see text)

One end of the decoupling resistor of the second r-f tube is supported on this lug and the other end on the 500-mmf button feed-through condenser passing through the shield which separates the second r-f compartment from the mixing compartment. The long leg of the plate tank loop of the second 2C40 is mounted on the other end of this by-pass condenser.

THE OSCILLATOR

The first section of the first 6J6 operates on the third overtone of the 7810 kc crystal. The second section triples to approximately 70.3 mc. The second 6J6 first doubles to 140.6 mc and then triples to 421.8 mc.

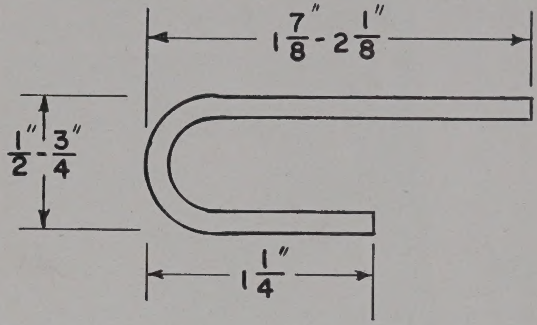


Fig. 5—Dimensions of the plate loops of the r-f stages. After pruning, the first r-f stage of the final model had the larger dimensions; the second r-f stage the smaller

These frequencies are approximate because the third overtone is not necessarily precisely three times the crystal fundamental.

While the lower frequency stages of the oscillator have been described many times in amateur literature and probably are quite familiar to amateurs who have crystal-controlled cascode receivers on 144 or 220 mc, the last tripler circuit needs some explanation and a little care in construction.

Resonance is obtained with a button ceramic standoff condenser, a tiny Johnson variable and a small loop made of a strip of copper 1/4 inch wide and 1 1/4 inches long. The copper is shaped into a loop with 1/2-inch

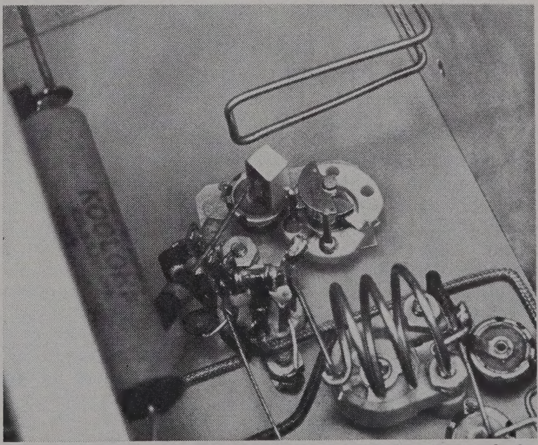


Fig. 6—Construction detail of the final stage of the oscillator

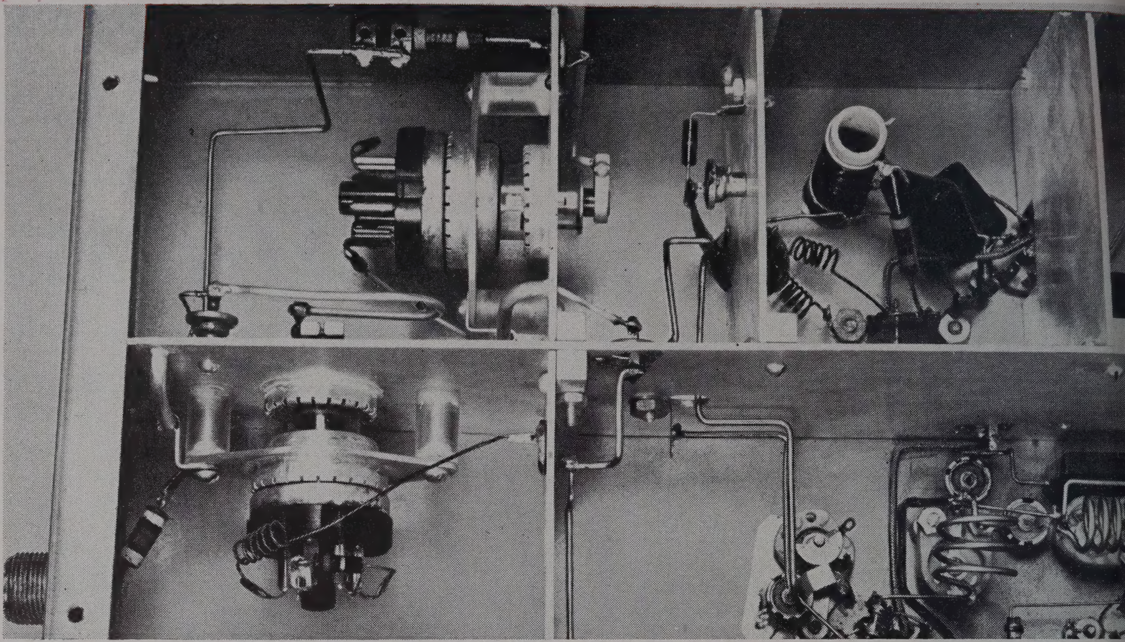


Fig. 7—Note cathode "coil" of 6AM4 in "mixing chamber" is a strip of copper extending from junction of resist and button standoff condenser down to pin 2 of the tube

legs as shown in Figure 6. The components are carefully mounted so that one end of the loop can be soldered to one of the stator posts of the variable and the other to the lug of the button capacitor. Initial inductance can be varied by the tolerance of about $\frac{3}{16}$ of an inch possible in soldering these connections.

Note, too, that these components are all mounted on a thin copper sheet approximately ¾ inches wide and 1¼ inches long to provide the best possible common r-f ground for the circuit. Once the correct range is found by adjusting the solder connections of the loop, most 6J6 tubes will resonate with the variable condenser. Resonance can be found by metering the oscillator plate current and noting a slight dip at the proper setting of the variable condenser.

A loop of No. 14 tinned wire couples the oscillator to the 6AM4 mixer, and can be adjusted for best results while listening to a local signal.

MIXER AND I-F AMPLIFIER

The cathode "coil" of the 6AM4 consists of a strip of flashing copper ¼ inch wide and 1¾ inches long. It is located in the mixing chamber as shown in Figures 1 and 7. One end goes to pin 2 of the tube socket, and the other end to a 500-mmf button capacitor mounted on the compartment shield. A 100-ohm resistor, also mounted on this condenser and visible in the photographs of the mixing chamber, provides cathode bias.

The shield between mixing chamber and the compartment which contains the remainder of the 6AM4 circuits is made with a notch ¼ inch deep and ⅝ inch long which fits over the 9-pin tube socket and serves to shield the cathode circuit from the plate circuit. The shield is placed so that three of the tube's five grid pins (1, 3 and 4) and the center shield of the tube socket can be grounded directly. The remaining two grid pins (6 and 9) are grounded to the center shield of the tu socket by a small strip of copper.

A similar shield, but with the notch ⅝ of an in deep, separates the input and output circuits of t 6AK5 i-f amplifier. Both mixer and i-f stages use slu tuned coils resonated at 12 mc with a grid dipper a loaded with resistance.

Output is taken from the 6AK5 by a six-turn link insulated wire which feeds to a coaxial chassis co nector. A short length of RG 58U coaxial cable brin the signals to the communications receiver.

PERFORMANCE

Two of these converters were built in the process design and development and both operated at fi trial. Best performance was obtained by pruning a adjusting the various r-f circuits. As neither a suitab noise diode nor signal generator was available for te ing, the adjustments were made with a specially bu grid dip oscillator covering 400 to 450 mc. The Sup 430 has lived up to expectations and is well worth t effort expended in careful construction.

While working with W2RMA, who designed t Super 430 Converter described in this issue of G HAM NEWS, we received a card from W3TE saying he would like to hear from fellows operating the 220- and 430-mc bands. . . . Ex-W2NX warns th use of a mineral type oil on a rope to lubricate ma pulleys (see Tricks and Topics, G-E HAM NEW March-April, 1953) may cause deterioration. He su gests use of a vegetable oil, pointing out that stitch canvas belting is impregnated with vegetable oil.

—*Lighthouse Lar*

SWEEPING *the* SPECTRUM

Once in a while a ham writes asking me to design a l amplifier for him—or sometimes a whole receiver. course, most fellows realize we can't do that, and fine their questions to specific problems—which we glad to tackle.

But let's look a minute at what it takes to design a eiver. Assume that the receiver is to have something cial about it—else why design something new? at means several weeks of development work, at the y least, to make sure the new twist is feasible. Then hes a period of building and testing which very likely l require the services of a good many people for an efinite time. Only then are we in a position to answer letter which asks in a sentence or so for a circuit t will do thus and so.

You may ask why not just write out a schematic and it go at that. Well, the answer is that I simply won't k my reputation on something that I'm not sure is ng to work. I remember once talking with a photog-pher who is reputed to be one of the best in the siness. He confided to me that he makes as many stakes as the average commercial photographer—but one ever sees them. For he never shows anyone a or picture. As a result he has a first-rate reputation. d he deserves it because everything he sends out is fect. But behind that perfection are untold hours of d work—taking shots over and over, making print er print until he has precisely what he wants.

Incidentally, that's a success formula anyone can ply in almost any line of endeavor.

* * *

While living temporarily in a room here in Schenec-ly, the boss—that's the editor, W2ZBY—set up a anut whistle on 10 meters to work the locals. He ports some of his best contacts are with his neighbor's sets. They read his voice and he reads their oscil-ors. He admits it's not an ideal two-way communi-tion system.

I was about to bawl him out for squirting harmonics over the street when he held up his hand and said at although neighbors complain, no Tennessee Valley dians cavort on his landlady's picture tube—even en he runs his powerful 6AQ5 up to full 10 watts put. So when neighbors ask what is he doing to louse their picture, he tells them that he is operating a dio station which is licensed by the federal govern-ent and transmitting on frequencies assigned by the deral Communications Commission. Then he points t that his landlady's TV set—the nearest one to him does not pick up the transmissions. And he suggests at something must be wrong with the complainant's V receiver.

* * *

Well, here are four letters from fellows who want to ow if they can be put on the mailing list to receive E HAM NEWS direct. I'll write them, as I usually , to the effect that while the publication is designed to be handed out through authorized G-E tube distributors, we do have a paid subscription plan for those unable to get their copies from a distributor. The cost is $1 a year, payable by check or money order made out to General Electric and mailed to me. I admit a dollar for six copies of a small eight-page magazine is not cheap. But as a matter of fact, we lose money on the paid subscriptions and accept them only to make sure everyone who needs or wants a copy of each issue can get it.

Another letter here comes from the secretary of a radio club who wants to know if we can send him 45 copies of each issue for the members. I'm sorry that I'll have to tell him that will not be possible. He will have to get them from the nearest G-E tube distributor, or individual members will have to subscribe. However, I will be very glad to send reasonable quantities of a specific issue of G-E HAM NEWS upon request for group use.

The next seven letters in the pile are from fellows who want specific back copies and some tube data sheets.

A fellow in Texas wants to know the ratings on a G-E transformer he has acquired in a swap. That may take some time. For I have to get the answers to such questions from some G-E department or division outside my own Tube Department. That means first finding out who would be most likely to have the answer—a job in itself in a large company like this—and then cajoling them into looking it up for us. And where an obsolete piece of equipment is concerned—like many pieces of surplus—actually finding the information becomes a project in itself.

Interest in SSB is running pretty high as we get requests for information on various points all the time. Here are three right now. W2KUJ helps out with such problems in most cases.

Now the complaint department. A fellow writes that he is unable to buy a certain condenser used in a gadget described in G-E HAM NEWS a year ago. Once again, all I can say is that we try to use standard parts that are readily available. But we have no way of guaranteeing that a particular condenser will be for sale in one of the radio stores in Oshkosh a year or so from now when W8??? decides to build that equipment. Naturally, when we learn of constant difficulties in obtaining a certain make of equipment we shy away from using them in published articles, although sometimes we get fooled this way, too. For it takes sometimes a year to develop an article for G-E HAM NEWS and perhaps by the time the articles get into the radio shacks all over the country that particular shortage is over. Believe me, if we could predict what will be available at any particular location on any particular day in any particular year—well, we'd be wasting our time here.

—*Lighthouse Larry*

Rat Trap Pulse Generator

DR. A. HARRY SHARBAUGH, W2UKL

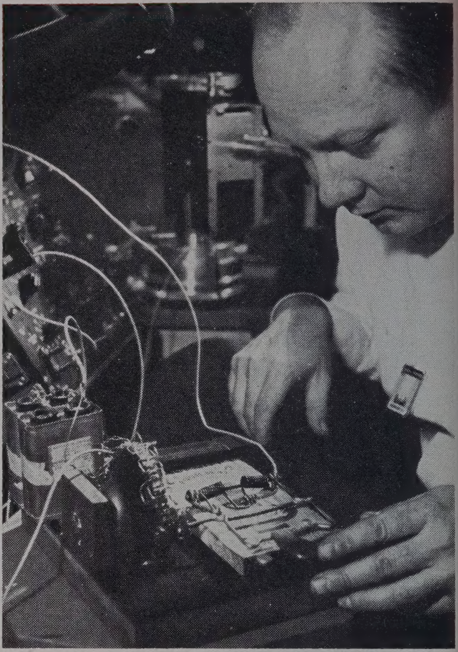
Once again a ham's ingenuity goes to work.

Dr. A. Harry Sharbaugh, W2UKL, is a chemist at G.E.'s modern Research Laboratory in Schenectady. But with all the advanced facilities available there—from glass blowing to hydrogen on tap in every room—what instrument does he select to test insulation? A rat trap!

Dr. Sharbaugh built the gadget shown at the right. Attached to trap is a carbon contact brush. When the trap is sprung, the brush sweeps across a stationary metal contact. For one thousandth of a second it connects a charged condenser to the insulation to be studied. An oscilloscope is used to measure the amplitude of the generated pulse.

Dr. Sharbaugh found that the trap gives dependable performance—reproducing the pulse accurately time after time. The tests are part of an over-all experiment to determine why electric charges break down various insulating materials.

Incidentally, Sharbaugh and R. L. Watters, W2RDL, also at the Research Laboratory—still hold the DX record for two-way phone communication in the 21,000–22,000 megacycle band. They were the first hams to use this band—the highest of the amateur frequencies—establishing their DX record of 800 feet on May 18, 1946.



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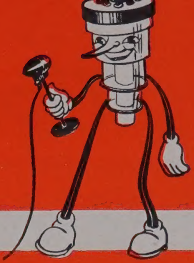

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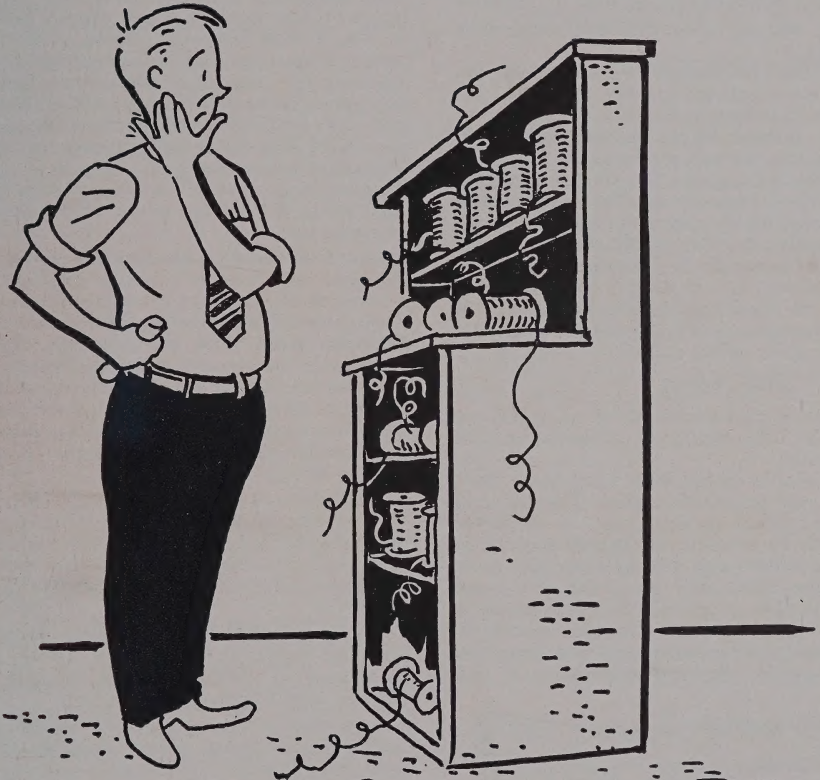
PTEMBER-OCTOBER, 1953 VOL. 8—NO. 5

TIPS ON WINDING COILS



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Tricks & Topics....pages 4-5
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Technical Information....page 8

Tips on winding coils

One of our readers recently made a Dioplex (HAM NEWS, Vol. 8, No. 3) and swore up and down that he copied everything exactly as described but the thing wouldn't work properly. Come to find out, he had made what he thought were unimportant substitutions. In the first place, he used a ceramic trimmer—which has a much lower Q than the mica trimmer specified. Secondly, and more important, he used a different size wire—the "nearest thing on hand"—in winding the coils.

Now, inasmuch as the Dioplex has relatively low capacity, this "slight" substitution of wire size resulted in additional distributed capacity which, percentagewise, was relatively large. However, when the coils were re-wound to proper specs, the Dioplex worked fine.

The incident prompted us to talk with an expert on the subject and so here are a few words of wisdom from W2PFU.

—*Lighthouse Larry*

COIL WINDING

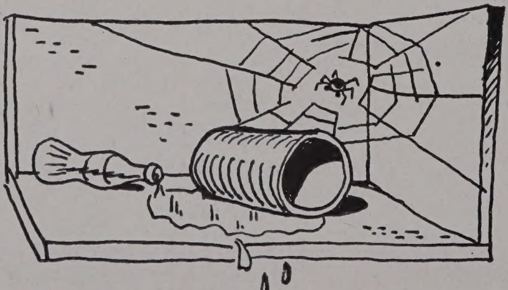
Almost all of the radio apparatus the average amateur uses involves wire-wound inductors, known generally as "coils." And unless the amateur has enough spending money to buy all of his equipment, and no interest at all in construction (definitely not an "average ham"), sooner or later he will be faced with the problem of winding such coils.

Now, very few amateurs design their own coils, and it would take far too much space to go into all of the factors involved in such design. Most of us pattern our gear after circuits printed in the various handbooks and radio publications, taking care to follow as closely as possible the directions given for the construction and the winding of the necessary coils. This is not always easy, however, as magnet wire comes in a great variety of wire sizes and with a number of different insulating materials. It not infrequently happens that when the coil design calls for, say, No. 29 double-cotton-covered wire, all we have on hand anywhere near that size is some No. 30 Formex wire. And when the nearest radio store is practically DX—what to do?

WIRE TYPES

To begin to answer this question, let's first take a look at some of the different types of insulated wire that are used for coils:

Black enamelled wire is coated with a baked-on resin film similar chemically to ordinary paint. This film has a moderate degree of heat stability, and its dielectric strength is adequate for amateur applications, but it is considerably more brittle and fragile than the resin film on Formex wire. Some varieties of this wire must be handled and wound very carefully to avoid cracking or peeling of the insulating film. Also, the enamel is easily softened by organic solvents, and may be accidentally removed by improper application of coil varnishes.



". . . susceptible to moisture and dirt . . ."

Formex is the registered trade-mark for G-E ma wire enamelled with a very tough golden-colored pla known as "formvar." This material is really tough; wire can be pulled, beaten, bent, and twisted to a markable extent without breaking the insulating f The insulation does not deteriorate at temperat at which the common black enamel fails rapidly, it has a high dielectric strength. It is not gre affected by most organic solvents and, all-in-all, considerably superior to black enamelled wire for m purposes. There are four grades of Formex wire- DF, TF, and QF—with successively thicker coat of enamel. For radio coil purposes the single thick F grade is eminently satisfactory. A sample of No. Formex wire, on which the enamel film was only .0 inch thick, did not fail under 1250 volts in a diele strength test.

Double-Cotton-Covered wire (d.c.c.) is, as the n implies, bare copper wire wound with two la (reversed) of cotton cord. Until impregnated with a dope, the cotton covering serves merely as a sp between turns. Thus, undoped coils close-wound d.c.c. wire are susceptible to moisture and dirt w may act to change the effective inductance and lo the Q of the coil. This type of wire is used ma where some spacing between turns is desired, since s construction gives somewhat higher values of Q t close-winding.

Single Cotton Enamelled wire (s.c.e.) is black ename wire covered with a single wrapping of cotton. Ex for the added spacing between turns in the wound it has no advantages over enamelled wire, and ma adversely affected with contamination unless nished.

Silk Covered wire (d.s.c.) is rarely specified nowad and may be difficult to obtain. It is doubtful if the s advantage in using this type of wire over cot covered wire justifies its extra cost.

Bare Wire or **Tubing** generally is used for coils widely spaced turns, such as high-power transmit inductors, in which there is no likelihood of turns b displaced and shorting.

HOW ABOUT SUBSTITUTIONS?

To find out something about the operational di ences between the various wire types and the c culties one might get into by making substituti several test coils were wound on ¾-inch polysty forms and measured on a Q meter.

Coils A and B were wound on ¾-inch Amph forms with 102 turns each of No. 30 black enamel and No. 30F Formex wire, respectively. Since

". . . can really get into trouble."

thickness of the enamel layer was nearly the same on both types of wire, the over-all lengths of the windings were close, $1\frac{1}{16}$ inches for coil A and $1\frac{1}{8}$ inches for coil B. At a frequency of 2 megacycles, coil A required 55 micro-microfarads to resonate, its Q was 122, and the distributed capacity was about 3.5 micro-microfarads. At the same frequency, coil B resonated with 65 micro-microfarads, its Q was 128, and the distributed capacity was about 2 micro-microfarads. All this means is that although Formex has slightly lower dielectric losses and a slightly lower dielectric constant than black enamel, the two types of wire are closely similar and could be used interchangeably except under more rigorous conditions of handling and operation where the superior physical properties of Formex would make it more desirable. Of course, using a wire with a thicker insulation, such as No. 30 TF, would change the above figures somewhat. The inductance of coil B was calculated to be 99 microhenries at 2 megacycles and actually measured 100 microhenries.

Sometimes coil designers specify length of winding only—rather than number of turns—and here is where the amateur constructor can really get into trouble.

Coil C was wound to the same length as coil B, but with No. 31F Formex, only one wire size different and almost identical in appearance. It had, however, 112 turns in the length of $1\frac{1}{8}$ inches. It required only 49.8 micro-microfarads to resonate at 2 megacycles, had a Q of 130, and a distributed capacity of about 3.5 micro-microfarads. Admittedly, the difference between 60.5 micro-microfarads and 49.8 micro-microfarads does not seem large, but remember that at amateur frequencies, considering stray capacitances, tube capacitances, and the distributed capacity of the coil itself, this difference might be significant in the operation of a particular apparatus. When ten turns were removed from coil C (leaving 102 turns), it resonated at 2 megacycles with 61 micro-microfarads; closer, but still over 8 percent off. Using a wire two sizes removed from the specifications and winding to equal length would result in a much larger departure from the specification described by the designer.

Coil D was wound to a length of $1\frac{1}{8}$ inches with No. 3 double-cotton-covered wire. It had only 62 turns, and required 173.5 micro-microfarads to resonate at 2 megacycles. The Q of this coil was 132, and the stray capacitance was about 3 micro-microfarads. This coil is almost hopeless as a substitute for coil A. It very possibly could not be made to resonate at the design frequency with the specified capacitance; and the chances are that if it could, the resulting impedance mismatch would result in impaired performance. (This mismatch would be almost 3 to 1, assuming that coil A was designed to match the circuit.)

The moral is clear—for a given coil diameter, the number of turns is the more important factor, and the coil length is of secondary importance. (The coil diameter is important too, but that is another matter.) So, if the circuit description says "take a 1- by 3-inch coil form and wind on 2 inches of No. 24 d.c.c. wire," you'd better get some No. 24 double-cotton-covered wire—unless you want to make the calculations to determine what other coil dimensions, together with what wire you may have, are necessary to match the inductance of the specified coil. The formulas can be found in a number of technical books, including the A.R.R.L. Handbook.

COIL WINDING HINTS

Incidentally, if you do have to design your own coils, here are a few handy hints:

1. The optimum shape of coil for a given inductance is neither a very long coil of small diameter nor a short wide coil, but one of intermediate proportions. A ratio of length-to-diameter of about 3 to 1 seems to be good practice. Most coils in commercial equipment can be taken as examples of reasonable proportion.
2. Although there will be a particular wire size best suited for a given frequency (highest Q), it generally is a safe procedure to use the largest wire size that can be wound with the required number of turns in the space available. Coils wound with some degree of spacing between turns generally have higher Q values than close-wound coils, but for many amateur applications the difference may not be very important. Optimum spacing is about equal to one wire diameter between turns.
3. Ordinary round wire is the best shape for the amateur frequencies. Stranded wire or "Litzendraht" is better at the broadcast frequencies, but poorer at amateur frequencies.
4. Application of a good coil varnish, such as the cement made under the G-E registered trade-mark Glyptal or Duco cement, to coils wound on low-loss forms will not appreciably change their performance, and generally should be made to protect the coils.

Preserving Antenna Components

If you want to protect wooden parts of masts, beams, and other structures from rotting—or if you want your antenna ropes to last almost indefinitely—try treating them with a strong solution of pentachlorphenol ("Pentide") before putting them up.

I had the unpainted bottom end of a 2x4 mast that had been soaked with this solution standing in swampy ground for over three years with absolutely no trace of rot or deterioration. I also soaked the antenna rope in the solution, letting it dry thoroughly before installation. It was just as strong after several years of exposure to the elements as the day I bought it.

DAL HURD, W2PFU

One Cure for Ignition Noise

> *The following trick for curing ignition noise brought to mind the article on noise elimination (QST, April, 1952) by W9DPI, supervisor, Engineering Research Department, Delco-Remy Division, General Motors Corporation. We asked his opinion. Following are both the trick of W9THD and comments by W9DPI.*
>
> —*Lighthouse Larry*

After trying all the usual stunts in removing ignition noise from my mobile receiving setup in the family gas buggy, I tried the following trick which proved so effective I am now able to receive most signals with my noise limiter switch in the off position.

First, remove the distributor rotor from the distributor. This is made accessible by disengaging the distributor cap clamps, laying the cap to one side and pulling the rotor from the shaft (it just pushes on the shaft like a push-on radio knob). Lay the metal tab (from which the spark is distributed to the various plug wires) on a flat steel anvil or dollie block and peen out with a small hammer. Repeat this until the tab just barely leaves a mark on the metal contacts inside the distributor cap checking it frequently so as not to "beat" the tab out too much.

This whole operation only takes about five minutes but it sure makes a world of difference in the noise in the receiver. In fact, most of my ignition noise comes from passing cars now.

GILBERT VOYLES, W9THD

We have never found an installation where all of the ignition noise originated in the rotor gap, which must have been the case in Mr. Voyles' car. In such a case, the solution he has evolved undoubtedly would greatly reduce the noise.

There are reasons why his procedure may be a dangerous one. The cap inserts are held in place by a thin plastic section. If extreme care is not used, the cap may become cracked in making the rotor insert longer. Manufacturing dimensional tolerances are such that in most cases the center of the insert radius is not exactly at the same point as the center of rotation of the rotor. This fact would lead us to conclude that quite a large amount of metal would have to be removed from some inserts to ensure a wipe contact on all. Removal of enough metal would further increase the possibility of breaking the cap, or of breaking the rotor.

In the higher compression modern engines, the ignition voltage requirement is greater than in older models. Since the frequency and wave front is essentially the same as has been used in ignition systems for some time, this means that a longer time has elapsed between the instant the breaker points separate and the instant the ignition voltage is great enough in magnitude to fire the plug. When plugs become aged they accumulate a deposit of relatively low resistance in parallel with the plug gap. This parallel resistance causes a loss in energy that is a function of

$$S^{t}\frac{e^{2}}{R}dt$$

where e is the instantaneous voltage across the plug, R is the resistance across the plug, and t is time measured from the instant voltage is impressed on the plug. Si the voltage is not impressed until the rotor gap is brol down, a reduction of rotor gap length will increase factor "t." The loss in ignition energy could well ca missing in an automobile that otherwise would oper satisfactorily.

We should recommend the use of 5000-ohm s pressors at each of the output towers of the distribut and a 10,000-ohm unit at the center tower to cure particular noise Mr. Voyles reduces by peening his rot

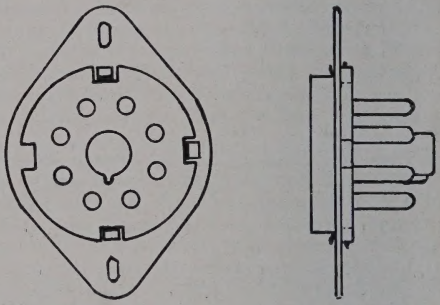
BROOKS H. SHORT, W9DP

Male Octal Chassis Connector

Here is an idea that I have used successfully several years. I would like to enter it in Tricks Topics in G-E HAM NEWS.

A very good octal male chassis-mounting connec can be made from the wafer base from an octal me (or metal-based glass) tube, and one of the me mounting plates supplied with retainer-ring moun tube sockets and 110-volt connectors made by Ampher

These plates have a 1⅛-inch diameter hole witl lug in them. This lug is filed down a bit, and the bent to one side of the plate a bit (perhaps 15 degr or so). Then the wafer base is inserted in the h with the lug fitting into one of the notches where tube skirt was originally crimped. The base is inser into the side of the plate towards which the lug bent. It will now be found that the other three notc appear as short slots on the other side of the pl Into these slots little strips of thin metal, about by ⅜ inches are inserted, bent back on both sides the plate, and crimped flat with pliers. That's all!



A few notes: Amphenol sometimes supplies a thic mounting plate. Only the thinner ones can be u here. They seem to be the commonest kind. Alsc vise or pair of pliers can be used gently to push the b into the plate. It is a good snug fit.

The connector can be mounted in a standard soc hole if the plate is mounted on the outside of the chas If a hole 1 5/16 inches in diameter is used, the plate be put inside. Perhaps the base could be put direc into a hole in the chassis without the plate, using strip of metal in all four notches. I have never tr this as my socket-hole punch is 1 3/16 inches. The b must be a snug fit in the hole.

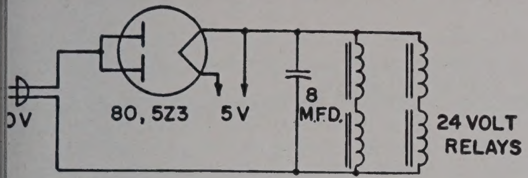
I hope you find this idea interesting. I have used lot and found it most satisfactory, especially as occupies almost no space under the chassis.

PHILIP H. BYRNE, VE3AX

TOPICS

Using 24-volt Relays

I have a trick to submit to your Tricks and Topics tion of G-E HAM NEWS. It concerns 24-volt plus relays which have no doubt been the subject many tricks. I have been using several in my rig obtaining power from a 5Z3 or 80 hooked up in a f-wave circuit with their plates tied together. The



put voltage of this supply with one 8-microfarad ndenser for filter is about 50 volts or sufficient to erate 2 relays in series, but the current available is ficient to operate two or three strings of relays.

The high vacuum rectifiers will also supply any ra current necessary to pull in some types of relays ich would damage the dry disk type rectifier unless s well over-rated under normal operating conditions. ost ham rigs will have the necessary 5-volt filament nding already available especially if any surplus nsformers are in the rig.

In closing, I wish to thank you for the large amount enjoyment I have obtained from G-E HAM NEWS.

HUGH E. WHITE, W4NOJ

Easy Way to Tap Poly

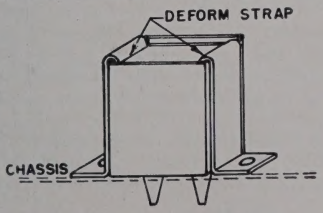
Plexiglas,. lucite, polystyrene, and other thermoastic compounds are easily tapped by means of the llowing kink. Drill with the proper size drill, fasten screw of the desired pitch and diameter to one of ose "snap on" screwdrivers and heat in a gas flame. he screw will cut a thread as if it were going through tter. Be careful not to get the screw too hot.

JOHN G. LAWTON, W2VYZ

Mounting Can Capacitors

Here is a little kink which may save some of your aders time and energy. It has to do with mounting e rectangular can-type high-voltage filter capacitors ter (in true ham fashion) the mounting brackets have en lost or diverted to some other use.

It will be observed that such can-type capacitors ve at both top and bottom a bead running all around e edge, and that this bead is about ⅛ inch high. ich capacitors are usually mounted with the terinals projecting through the chassis.



Measure the distance across the capacitor inside e beaded edges, and fabricate, from soft aluminum .040 or .051 thick, a mounting strap to pass over the capacitor. The width of this strap should be slightly less than the distance between the beads on the capacitor. Bend "feet" at the ends of the strap to permit mounting to the chassis.

Punch the chassis to pass the terminals, fit the strap over the capacitor, and bolt to the chassis. It will be observed that some motion of the capacitor is still possible. To eliminate this motion, place the end of a screwdriver blade on the aluminum just inside the corner of the bead and rap smartly with a hammer. Do this at each corner of the capacitor bottom. The screwdriver blade will deform the aluminum, pressing down a small section. These pressed points seize the inside of the bead at each corner and prevent further movement.

HOWARD A. BOWMAN, W6QIR

Low Drain Pilot Lamp System

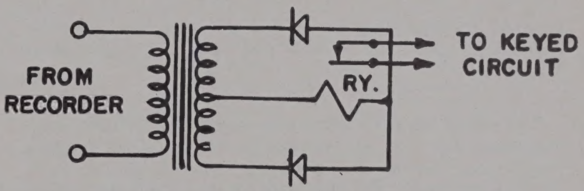
Effective and lower power consumption pilot lamps on 110-volt lines can be economically made with 200,000-ohm resistors in series with NE-2T pigtail type neon lamps.

Space and money can also be saved by mounting the little lamps inside grommets ¼-inch inside diameter. This type pilot lamp draws about 1/25 of a watt—as compared with at least 6 watts drawn by a standard 110-volt pilot lamp.

HERMAN H. ROSS, JR., W6WYF

Transmitting Recorded CW—on CW!

To retransmit recorded CW contacts in the fone bands all you have to do is set the mike in front of the tape or wire recorder and turn on the rig and recorder. But how to retransmit such recorded CW contacts on CW? Here's how I solved the problem of converting the a-f output of the recorder to mechanical action that will key my transmitter.

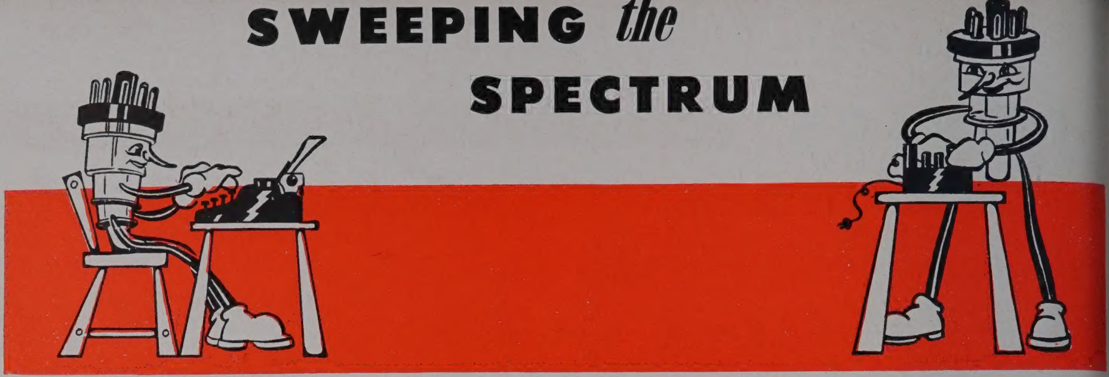


As the accompanying diagram shows, all you need is a line-to-grid transformer, a couple of germanium diodes, and a 10,000-ohm plate relay. I use a BK-35 plate relay bought in the surplus market.

GEORGE BEAN, W5DVI

How did you solve that last problem that almost had you stumped? Be it about tubes, antennas, circuits, etc. Lighthouse Larry would like to tell the rest of the hams about it. Send it in! For each "trick" published you win $10 worth of G-E Electronic Tubes. Mark your letter "Entry for Tricks and Topics" and send to Lighthouse Larry, Tube Department, General Electric Company, Schenectady, New York, or in Canada to Canadian General Electric Company, Ltd., Toronto, Ontario. The Companies shall have the right, without obligation beyond the above, to publish and use any material submitted to this column. No entries returned.

SWEEPING *the* SPECTRUM



Quite a few of the editors of radio club bulletins send us copies of their publications and we sure enjoy reading about what the boys in the different sections of the country are doing. If your club puts out a regular bulletin or newsletter of any kind, please tell the editor that we will be glad to exchange publications with him.

And speaking of club newspapers, I'd like to pass on the comment from several fellows to the effect that a club publication—be it the humblest sort of mimeographed job—helps tremendously in keeping the members interested in club activities. It's our firm belief that every club should have one.

The cost is not prohibitive. The principal stumbling block is the work involved. In the first place, it should not be made a one-man job. The load generally is just too heavy for one man. A club bulletin should be run by a standing committee—call it the editorial board if you like. You need at least one member to write news, and the chances are that he could use a helper or two to gather the news. Then you need a member to handle the production—be it mimeographed, hectographed, or printed. And, with a publication of any size, this production man can use some help, too. The third problem that needs careful attention is distribution—which means for the most part, addressing and mailing. At least one member is needed here.

Of course, with small clubs and small bulletins it is quite possible for one member to handle all these items. But while the complete production of one issue of a small publication is not difficult, the tiring part is the repetition of this work load time after time. And so we suggest splitting up the work on even the smallest publication between at least two members—preferably three.

⁂ ⁂ ⁂

The editor came in looking pretty down-in-the-mouth the other day and we learned the source of his sadness was trying to substitute a 6S8 for a 6B8 in his receiver. He has a surplus BC-348 and wanted the extra diode in the 6S8 for a noise limiter. This stunt has been used successfully in many mobile installations. But apparently the BC-348 is quite another matter. He never did get to building the noise limiter on that diode because he found that when he changed pin connections and plugged in the 6S8 about 40 different things happened. In the first place, the audio volume nose-dived. He brought this up by changing the cathode resistor associated with the triode section of the 6S8. Secondly, he had objectionable distortion which he thinks he might have eliminated if he had worked on it long enough. But the thing that bothered him most was that apparently one of the effects of leaving the screen connection from the 6B8 hanging was to knock the daylights out of the operation of his CW oscillator.

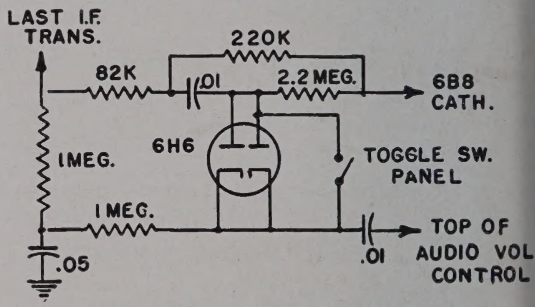
We looked at his schematic and began to list the additional changes he would have to make. For the BC-348, like many good pieces of equipment, is designed as a unit in which all stages and sections are interdependent in varying degrees. Changing one pa requires changing many others.

But he interrupted.

"Larry, if you think I'm going to change the desig of the receiver to put in a noise limiter, you're nuts."

"If you think you're going to go substituting tub without regard for the design, then you're nuts," w retorted.

We compromised. He put in an extra tube—a 6H6— for his noise limiter. The reason he didn't want to d this in the first place is that he is still using the origin 24-volt filament string with a special transformer he g hold of somewhere and he didn't want to disturb th string with an extra tube. In the end, though, he put i a small filament transformer for the 6H6. Incidentall we stopped out at his house a few days later and h demonstrated the noise limiter. Works good. In ca you're interested, here's the circuit, which he says h got from W2BPU and W2CVF:



⁂ ⁂ ⁂

It seems most of the objections to single-sideban operations come from fellows who say they "tur across an SSB signal and find it just as wide as an A signal." That complaint precisely points up the purpos of a single-sideband receiver adapter such as the "Signal Slicer" (G-E HAM NEWS Vol. 6, No. 4).

For although you can receive SSB signals with a ordinary communications receiver, you cannot get fu advantage of the relative narrowness of an SSB signa without a "Signal Slicer" or the equivalent. And yo can't lose by installing a "Signal Slicer" because it wi slice out QRM when copying AM, CW or NBFM, to

To conveniently answer the increasing number o requests for general information about our SSB equipment, I've gotten up an "SSB Package" consisting o copies of G-E HAM NEWS which describe the "Signa Slicer," "SSB Jr.," "Lazy Linear," and "Powe Peaker." Let me know if you want a set of these.

— *Lighthouse Larr*

Again, for 1953

THE EDISON ADIO AMATEUR AWARD

The Award Committee solicits your nominations for 1953 candidates

PRESENTED TO
WINNER OF THE
1953 EDISON RADIO AMATEUR AWARD
IN RECOGNITION OF
OUTSTANDING PUBLIC SERVICE
TUBE DEPARTMENT
GENERAL ELECTRIC

Here is your opportunity to spotlight the meritorious work of a radio amateur you may know who has served the public by means of his hobby. Enter his name for the Edison Award.

You will be promoting the best interests of amateur radio, and you can win for yourself an expense-paid trip to the city where the Award will be presented. Judges will consider only amateurs who are nominated by your letters.

1952 saw Don Mullican, W5PHP, receive the Edison Award as a result of his outstanding work in the March tornado disasters in Arkansas. Special citations also were given four other amateurs who performed especially notable services.

The acclaim for these five was a tribute to the important and unselfish efforts of amateurs everywhere. The 1953 Award will bring recognition to a new trophy winner—will once more dramatize amateur radio's achievements in the public interest.

Read the rules at right. Then select your candidate . . . and send your letter of nomination to *Edison Award Committee, Tube Department, General Electric Company, Schenectady 5, New York.*

RULES OF THE AWARD

WHO IS ELIGIBLE: any man or woman holding a radio amateur's license issued by the F.C.C., Washington, D. C., who in 1953 performed a meritorious public service in behalf of an individual or group. The service must have been performed while the candidate was pursuing his hobby as an amateur within the continental limits of the United States.

WINNER OF THE AWARD will receive the Edison trophy in a public ceremony in a centrally located metropolitan city. Expenses of his trip to that city will be paid. As a further token of appreciation, G.E. will present him with a precision chronographic watch to clock DX. In addition, the person responsible for the nomination of the Award-winning candidate will be invited to attend the presentation ceremony, and his expenses also will be paid.

WHO CAN NOMINATE: any individual, club, or association familiar with the service performed.

HOW TO NOMINATE. Include in a letter the candidate's name, address, call letters, and a full description of the service performed. Your letter must be postmarked not later than January 3, 1954.

BASIS FOR JUDGING. All entries will be reviewed by a group of distinguished and impartial judges. Their decisions will be based on (1) the greatest benefit to an individual or group, (2) the amount of ingenuity and sacrifice displayed in performing the service. The judges will be:

E. ROLAND HARRIMAN
President, The American Red Cross

GEORGE E. STERLING
Commissioner, Federal Communications Commission

GOODWIN L. DOSLAND
President, American Radio Relay League

GARDNER COWLES
President and Editor, "Look" Magazine

WINNER WILL BE ANNOUNCED on or before Thomas A. Edison's birthday, February 11, 1954.

Employees of the General Electric Company may nominate candidates for the Edison Radio Amateur Award, but are not permitted to receive the Award.

GENERAL ELECTRIC

166-1B9

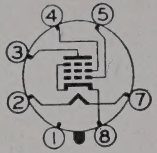
1878 75 1953
YEARS OF ELECTRICAL PROGRESS
Diamond Anniversary

Technical Information 12V

GENERAL DESCRIPTION

Another addition has been made to the 6V6 family—the 12V6-GT. This is a 12-volt filament version of the beam power pentode, and was designed for use in auto radios operating on the new 12-volt ignition systems. Amateurs undoubtedly will have occasion to use the 12V6-GT as 12-volt auto systems come into more general use in the next few years.

BASING DIAGRAM



MAXIMUM RATINGS

Heater Voltage (a-c or d-c)	12.5 Volts
Heater Current	0.225 Amp
Plate Voltage	315 Volts
Screen Supply Voltage	315 Volts
Screen Voltage	285 Volts
Plate Dissipation	12.0 Watts
Screen Dissipation	2.0 Watts
Heater-cathode Voltage	90 Volts
Grid Number 1 Circuit Resistance:	
With Fixed Bias	0.5 Megoh
With Cathode Bias	1.0 Megoh

TYPICAL OPERATION

CLASS A$_1$ AMPLIFIER

Plate Voltage	180	315 Volts
Screen Voltage	180	225 Volts
Grid Number 1 Voltage	−8.5	−13.0 Volts
Peak A-F Grid No. 1 Voltage	8.5	13.0 Volts
Plate Resistance (Approx)	50000	80000 Ohms
Transconductance	3700	3750 Mho
Zero-Signal Plate Current	29	34 Ma
Max.-Signal Plate Current	30	35 Ma
Zero-Signal Screen Current	3	2.2 Ma
Max.-Signal Screen Current	4	6 Ma
Load Resistance	5500	8500 Ohms
Total Harmonic Distortion	8	12 %
Power Output	2.0	5.5 Watts

CLASS AB$_1$ AMPLIFIER (VALUES FOR TWO TUBE

Plate Voltage	285 Volts
Screen Voltage	285 Volts
Grid Number 1 Voltage	−19 Volts
Peak A-F Signal Voltage (Grid to Grid)	38 Volts
Plate Resistance (Each Tube)	70000 Ohms
Transconductance (Each Tube)	3600 Mho
Zero-Signal Plate Current	70 Ma
Max.-Signal Plate Current (Approx)	92 Ma
Zero-Signal Screen Current	4 Ma
Max.-Signal Screen Current (Approx)	13.5 Ma
Effective Total Load Resistance (P-P)	8000 Ohms
Total Harmonic Distortion (Approx)	3.5 %
Power Output	14 Watt

Electronic TUBES

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G-E Electronic Tube Distributors

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S. E. McCALLUM, W2ZBY—EDITOR

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Electronic
TUBES

Ham News

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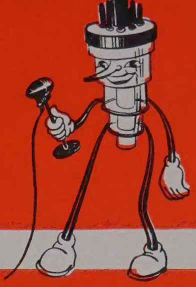
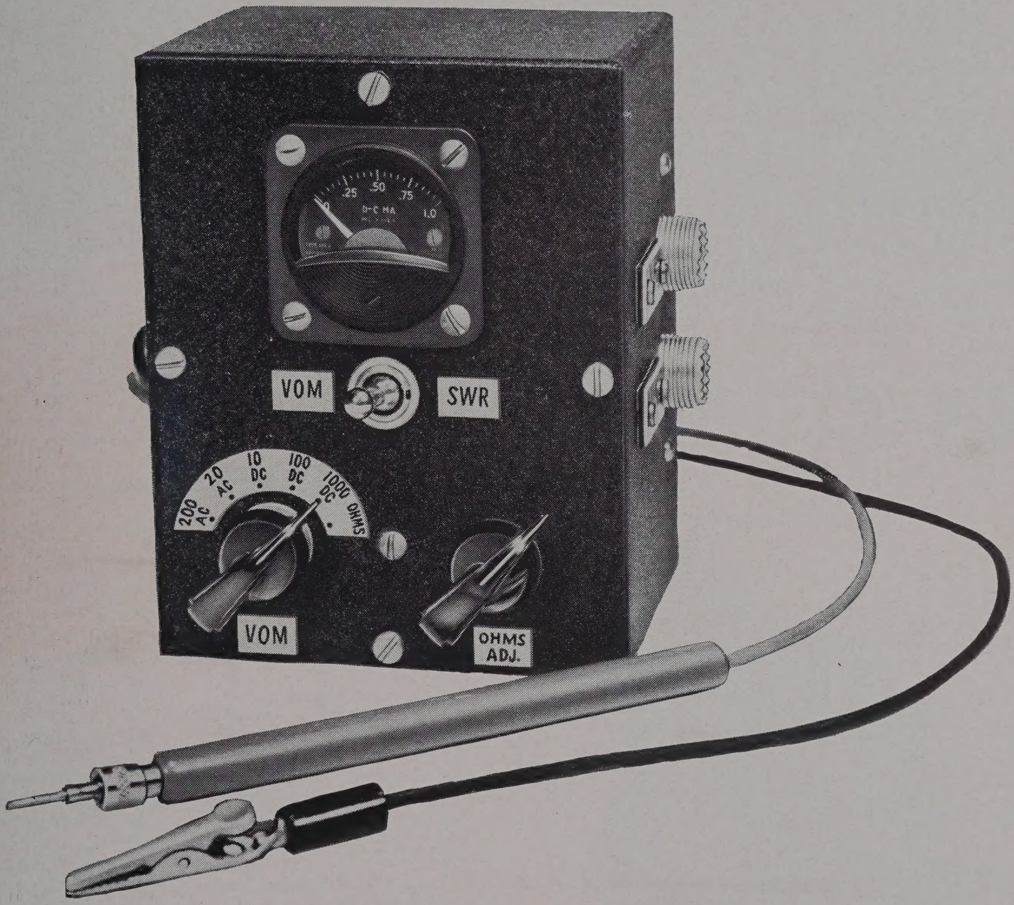
VOL. 8—NO. 6



The FIELD METER

A Handy AC-DC Voltmeter, Ohmmeter and SWR Bridge


.25
.50
.75
1.0
D-C MA
VOM
SWR
200 AC
20 AC
10 DC
100 DC
1000 DC
OHMS
VOM
OHMS ADJ.

Also—How Tubes Are Numbered—P. 4

Contents

Field Meter....page 2
Tube Type Designation Systems....page 4
Sweeping the Spectrum....page 7
"Operation Bump"....page 8

THE FIELD METER

The idea for the Field Meter was born the hard way—after a particularly tough and disappointing Field Day. The designer—W2FZW—vowed that he would have a capable instrument on his next field operation, one that was not an expensive piece of equipment that had to be treated like a baby.

He listed the minimum field requirements and then set about planning what turned out to be this Field Meter. Its simplicity, versatility and low cost make it a handy gadget to have around the shack. Or perhaps just the simple SWR bridge will be the only part many fellows are interested in.

—*Lighthouse Larry*

Few hams like to take their pet—and expensive—test instruments on Field Day or vacation. But something adequate often is needed because all too often bench-tested equipment plays tricks under portable conditions. The Field Meter combines field needs in an unusual and relatively simple and inexpensive way.

A 200-volt a-c range permits checking primary and control circuit operation. A 20-volt a-c range allows checking filament or heater voltages of nearly any tube combination encountered. A 10-volt d-c range can be used to check battery voltages and cathode bias in audio or receiver circuits. Incidentally, if 100-ohm resistors are inserted in supply leads to tubes, this 10-volt d-c range can be used to check currents up to 100 milliamperes by measuring voltage drops. (A curve for this could easily be drawn.)

The 100-volt d-c range will check modulator or transmitting tube biases. The 1000-volt d-c range will check plate voltages. The ohms range (1500 ohms center scale) is primarily for continuity checks, but can be calibrated to read fairly accurately in the range of 0–20,000 ohms if desired.

DESIGN CONSIDERATIONS

Accurate VOM-calibration—and precision resistors
were not considered necessary in an instrument who
principal purpose is trouble-shooting. Circuits usual
do not stop working because some voltage is 10 p
cent off design value, but rather because failure of a co
ponent has drastically changed the voltage at some poi

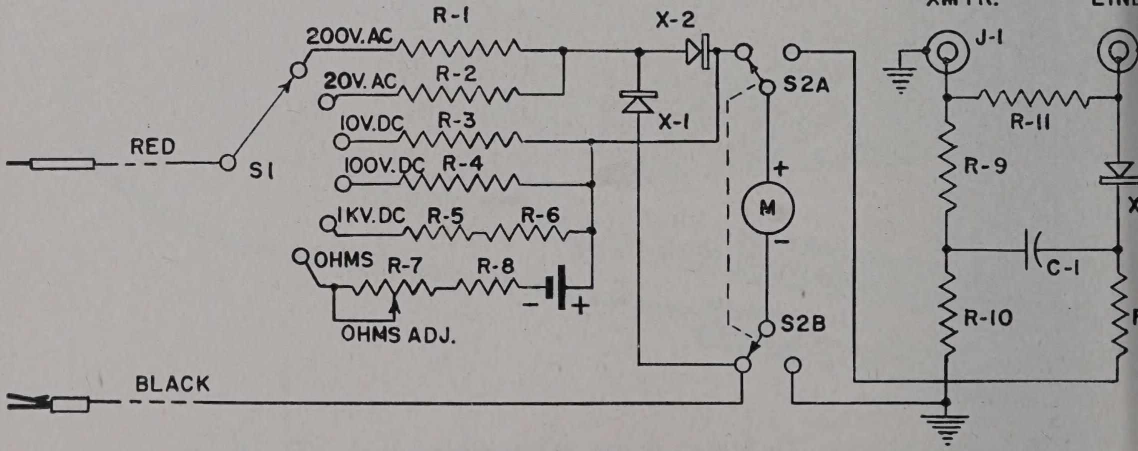
A word of caution. Do not try to simplify the a
voltage circuit by using a single diode for a half-wa
rectifier. The two-diode rectifier shown is necessa
to withstand the excessive a-c back voltage whi
appears when the meter is used on 200 volts a-c.

THE SWR BRIDGE

The Standing Wave Ratio Bridge in the Field Met
is tremendously useful in field operations. The i
pedance of an antenna changes with its surroundin
height above ground, and many other things. Thus it
particularly important—especially with portable a
tennas and equipment—to have some means of chec
ing results as reactance and impedance are adjusted
a value that is easily handled by the transmitter.

It is practical for portable operations to design t
transmitter to work into 50 ohms resistance—fix
coupling—and then make all field adjustments
means of an antenna coupler to obtain the requi
50-ohm load for the rig. With the SWR bridge, t
is but a few minutes' work and guarantees top p
formance, RF-wise. Incidentally, the same bri
circuit can be used for 75-ohm coaxial lines by mak
R_{11} 75 ohms instead of 51 ohms.

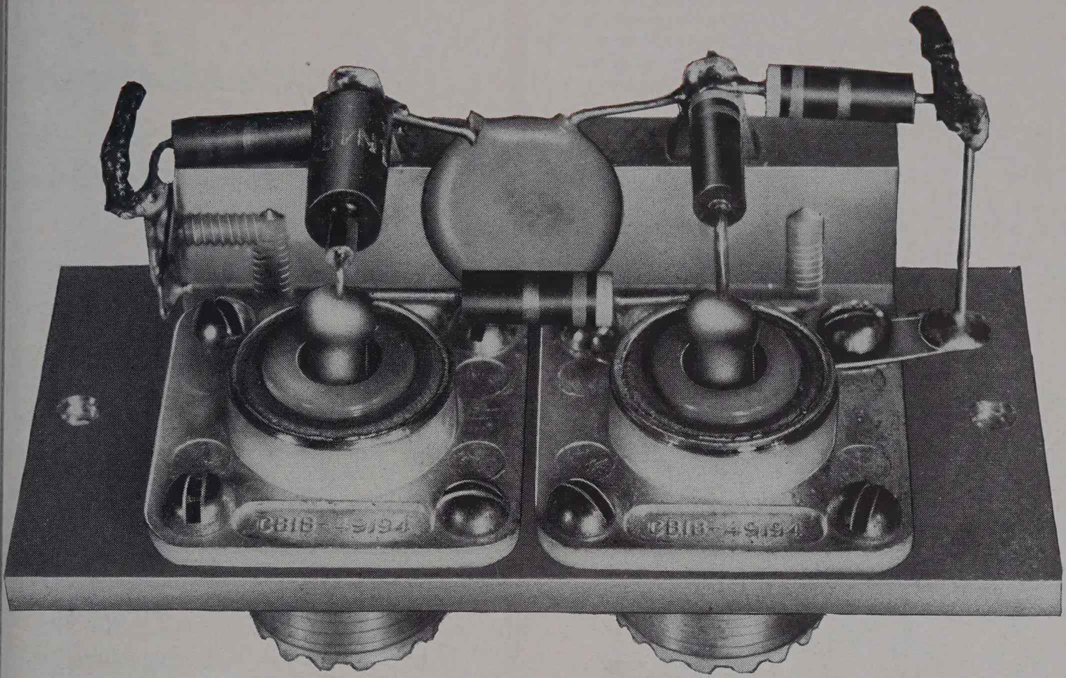
To use the bridge, the transmitter and line cab
first are reversed and the input cable loosely coup
to the final tank of the transmitter until full-sc
reading of the meter is obtained. Then the cable c
nections are made as indicated in the schematic d
gram. With a 1:1 SWR, the meter reading will be cl



Circuit diagram. All resistors half-watt

C_1—.005 mfd
R_1—90,000 ohms (1 megohm in parallel with 100,000 ohms)
R_2—9000 ohms
R_3—10,000 ohms
R_4—100,000 ohms
R_5, R_6—.5 megohm
R_7—1000-ohm wirewound potentiometer
R_8—1000 ohms

R_9, R_{10}, R_{11}—51 ohms
R_{12}—5100 ohms
X_1, X_2, X_3—1N48 crystal diode
J_1, J_2—coaxial connector
S_1—6-position selector switch (Mallory 3226J)
S_2—DPDT toggle switch
Battery—1.5-volt cell
M—0–1 ma. meter


Short leads in the bridge

zero—in other words, the meter will show a null t indicates perfect match.

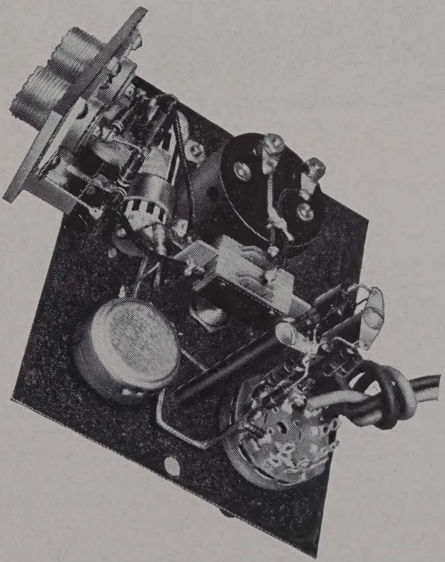
A higher meter reading will indicate somewhat less n perfect match. Actually, the bridge may be brated for SWR by replacing the transmission line h load resistors of varying values and checking ter readings—making sure to first adjust the loading precisely full scale each time. For instance, a resistor -half or twice the value for which the bridge is anced will give a reading which can be calibrated a 2:1 SWR. While non-inductive wirewound resistors uld be used for calibrating, ordinary composition istors will give sufficiently accurate calibration to isfy field needs.

CONSTRUCTION

Construction of the Field Meter was planned so components except those of the SWR bridge could mounted on one of the 4 x 5-inch panels of a 3 x 4 x nch utility box. Although it is possible to fit the rts into a smaller box, the panel-mounting type nstruction makes building and servicing the unit sier and allows all controls to be placed on the front.

Careful placement of the meter, switches, battery d potentiometer are the first job. A handy way to ake sure the parts will clear the lip of the box is to aw a half-inch margin around the edge of the inside the panel. Placement of parts also must allow room the bridge circuit which is mounted on the two axial connectors inside one side of the box as shown the photographs.

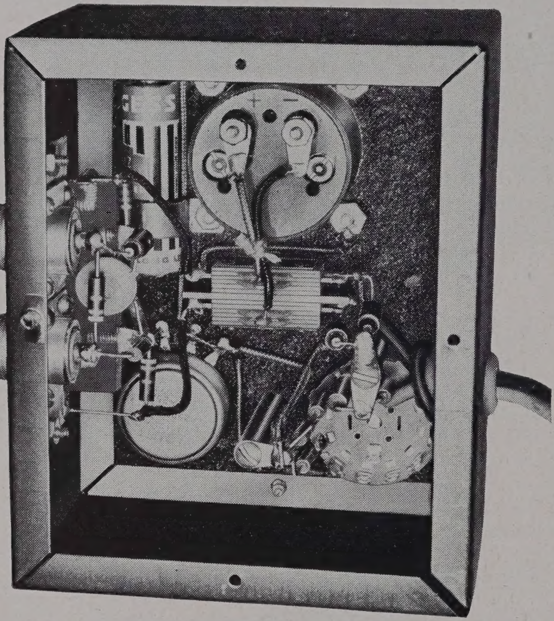
Once VOM parts are mounted, the resistors and odes associated with the VOM can be wired into place. As always, care should be taken to correctly polarize the diodes. The G-E 1N48 diodes are clearly marked with the standard crystal diode symbol.


This construction eases wiring job

The FIELD METER *(cont'd)*

In the model shown, two stand-off insulators made of 1¾-inch lengths of ¼-inch bakelite rod tapped at each end support soldering lugs which act as tie-points for the resistors and diodes of the VOM. Although these insulators are not absolutely necessary, they do give added support which may be of value in an instrument that goes through the trials and tribulations of portable or mobile operation—whether it be Field Day, emergency or vacation.

At first it was planned to mount the coaxial connectors directly on the box—thus building the bridge in place more or less permanently. However, the final design called for a separate mounting plate for the coaxial connectors, thereby allowing the SWR bridge to be built and mounted inside the box as a complete unit with permanent rigidity, and providing a better RF ground. This plate is of ⅛-inch aluminum stock 1¼ inches wide and 2¾ inches long. The coaxial connectors are mounted with machine screws tapped into the aluminum mounting plate.



Compact—but not cramped

A block of ¼-inch polystyrene ½ inch wide and 2 inches long was drilled, tapped and fastened as shown on the edge of the aluminum mounting plate alongside the coaxial connectors with flat-headed machine screws countersunk into the aluminum plate. This block provides two well-insulated tie-points for joining components of the bridge. Actually, ordinary tie-point lugs would probably serve just as well.

The layout and construction shown satisfies the only critical requirement of the instrument—short leads in the SWR bridge itself.

TUBE TYP

Exceptions
in numberi

If, as the saying goes, "an exception proves the
then the rules governing the designation of radic
by numbers and letters are exceptionally well-pro
For electronic tube numbers are like French v
more exceptions than rules. However, believe it
there *is* a system—several of them, in fact—a
occasion it helps to know what the various numb
number-letter combinations mean.

Three standard systems now are recognize
used by most tube manufacturers. These are:
receiving type system, (2) a cathode-ray syster
(3) an industrial and transmitting type system.
have been established as standard by a joint com
of two associations of manufacturers—the
Electronics and Television Manufacturers Asso
(RETMA) and the National Electrical Manufac
Association (NEMA).

Unfortunately, many tube types pre-date the s
now being used, and as a result we have severa
dred cases in currently used tubes where the nu
do not follow the aforementioned systems. Also
manufacturers still use numbering systems o
own instead of conforming to the voluntary sta
set up by the joint committee mentioned above.

A brief review of the current numbering syster
some of those used in the past may help amateur
when they browse through a tube manual, get th
ing they are wandering about in an unexplored

RECEIVING TUBE TYPES

Back in the 1920's, each manufacturer numbe
otherwise named his tubes as he saw fit and
very soon got very messy. The replacement p
was headed toward becoming unsurmountabl
so in 1933 the industry adopted the first vol
standard numbering system—which although
been since modified several times—still is used
for receiving tubes. This system calls for a num
letter, and another number. An example is o
friend, the 6L6.

The first number symbol determines the fil
voltage within a certain range, to wit:

Rated Filament or Heater Voltage	**S**
Zero..	
In excess of 0 and up to and including 1.6..........	
In excess of 1.6 and up to and including 2.6.........	
In excess of 2.6 and up to and including 3.6.........	
In excess of 3.6 and up to and including 4.6.........	
In excess of $n-0.4$ and up to and including $n+0.6$ wh n is any integer................................	

ESIGNATION SYSTEMS

the rules
dio tubes

he letter or letters in the middle are merely serial nations—with two letters being used when manu- rers run out of single letters. Today the letters and P are never used—and also, double combina- such as "AA" are never used.

he final symbol in this system consists of one or digits which indicate the number of useful ele- s for which terminals are provided. This includes rate internal shield and shell connections. A few checks with the standard base diagrams (which used in the ARRL Handbook and G.E.'s tube uals) will show how this final symbol works out.

ten a suffix is used in this receiving type system. e, and their meanings, are: G—glass with octal ; GT—same except with a 1 and 1/8-inch eter tubular bulb (known as T-9 size); M—metal- ed glass with octal base; X—low-loss base; Y— mediate-loss base; and W—military type tube. A d suffix—which may be A, B or C and so on— s a superseding version of the same type which, rding to the rules of the game, can be plugged into same socket and should give as good or better rmance.

" . . . things got very messy."

That is the currently-accepted receiving tube type designation system. But there are many exceptions. Numbers like 41, 80 and 12A carry over from previous years. We find another type of exception in the so-called "loctal" tubes whose designations all begin with a "7"—such as the 7C5. Obviously this plan does not conform to the filament voltage code above. Other exceptions have come about because the original purpose of certain tubes was not for "receiving." That is, some tubes often are used now for receiving purpose but were originally designed, and numbered, in accordance with some other system. Samples of this type of exception are the 9002 and quite a few tubes in the 5500 series.

CATHODE-RAY TUBES

Being the baby of the family, the cathode-ray tube had a system slapped on it before it was hardly dry behind the filaments. As it now stands, this system calls for a number symbol which tells the maximum diameter or diagonal of the face in inches, a letter which is merely a serial assignment, and a letter-number symbol which designates the type of phosphor used. For example, the 16RP4 has a diagonal of 16 inches and P4 phosphor coating inside the face. However, there are a few exceptions—like the 905, 908, 1803 and so on.

TRANSMITTING TUBES

Under the inglorious heading of "tubes and devices exclusive of receiving and cathode-ray tubes" amateurs will find their favorite transmitting "bottles" labeled with various and sundry letters and numbers which mean little, if anything.

The numbering of transmitting tubes was not standardized until 1942. Thus many tubes still being manufactured carry numbers and/or letters originally assigned under systems started by different manufacturers. For instance, the famous 807 and its brothers and sisters in the 800-series are carry-overs from private pre-war numbering systems. So are tubes in the 200- and 400-series.

In 1942 a standard number-letter-number system for transmitting and special purpose tubes was adopted—a plan which lasted only four years. However, a great many tubes still popular with hams were assigned numbers under this system. Samples are the "Lighthouse" series like the 2C40 et al, the 4D32, 2E26 and others. Under this system, the first number symbol was assigned to indicate power rating of the heater or filament as follows:

Filament or Heater Power	Symbol
Zero	1
In excess of 0 watts and up to and including 10 watts	2
In excess of 10 watts and up to and including 20 watts	3
In excess of 20 watts and up to and including 50 watts	4
In excess of 50 watts and up to and including 100 watts	5
In excess of 100 watts and up to and including 200 watts	6
In excess of 200 watts and up to and including 500 watts	7
In excess of 500 watts and up to and including 1000 watts	8
In excess of 1000 watts	9

Next, a letter symbol indicated the structure and/or function of the device in accordance with the following schedule:

Type	Symbol
Monode	A
Diode	B
Triode	C
Tetrode	D
Pentode	E
Hexode	F
Heptode	G
Octode	H
Vacuum capacitors	L
Crystal diodes and rectifiers	N
Photo-emissive devices, etc	P
Mercury types	R
Vacuum contactor-type switches	S

Finally, a number symbol constituted a serial designation, and these serial numbers started with 21 to avoid conflict with the receiving type designations.

In 1946 this system was scrapped in favor of a pure numerical serial system starting with 5500—the system which is in effect today. Thus many of the newer tubes used by amateurs are appearing with numbers in the 5500's and 6000's. Of course, as this "5500 system"—as it is often called—officially includes special purpose devices, hams will find a great many industrial tubes mixed in with the newer transmitting types of interest in ham operations.

Neither of the two systems outlined—nor any of the private numbering systems—was made retroactive. Thus some tubes now bear complex numbers relating to more than one system. This gets a little bulky but does tell the story. Witness the GL-4D21/4-125A. Here the "GL" denotes a General Electric Company tube and the "4D21" and the "4-125A" explain how the tube has been listed under two different numbering systems.

" . . . *not the original purpose.*"

GERMANIUM PRODUCTS

Under the long-hair title "solid state devices" we find one very old friend of the amateur—the crystal diode—and one very new friend—the transistor. While at this writing the numbering system for such devices has not been officially promulgated by the joint designation committee of RETMA and NEMA, there *is* a system in use—a system which stems from the 1942-1946 transmitting tube system outlined above.

When crystal diodes began to be numbered—such as the 1N51 et al—the first symbol (the number "1") was in accordance with the 1942-1946 code and indicated zero power filament or heater. The second symbol, the "N," indicated a crystal device. The last number was merely a serial designation.

Then the transistor came along and began to carry numbers beginning with "2N—." (G-E junction-type transistors, for instance, are designated 2N43, 2N44 and 2N45.)

Some manufacturers now want to code "solid state devices" by a system which in effect would pick up the pieces of several broken-down systems. They feel that it should go like this: The first number symbol would indicate the number of elements minus one—thus a 1N51 is a diode, a 2N45 a triode and so on; the "N" would indicate a "solid state device"; and the last number would be a serial designation. However, such a coding system has not been officially adopted.

* * *

As long as this is a free country no manufacturer ever will be bound to adhere to a standard tube numbering system. He can call his tubes anything he likes

However, most manufacturers today do their best to ease the replacement problem by going along with the decisions of the majority on a voluntary basis.

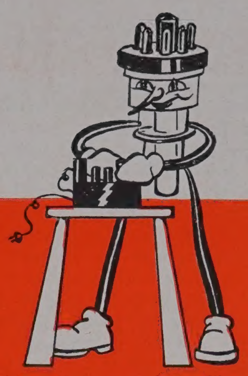
This question sometimes arises: Just who decides precisely what number shall be assigned to a particular tube type under any of the currently-effective designation systems?

The answer is that RETMA registers all tubes upon request of manufacturers, assigning the next open number in the system in question.

* * *

Now on the basis of the above rules and exceptions could you make up your mind whether or not to use, say, an 862A in your next rig? Chances are you can't—and the chances are, further, that you won't bother to try when you find out that although this bottle has a 200-gallon input rating (and should run cool on the ham bands), it lists at $1322.00.

SWEEPING *the* SPECTRUM



A new set of TVI problems looms as the new UHF annels come into use. Usually the fault of TVI is not e ham's. But unfortunately our friends and neighbors n't understand the technical problems involved. So is up to us to tell them, softly and gently (even ough it's sometimes awfully tough to hold our npers). And having told them once is not enough.

Good public relations is no one-shot affair. It has to a continuing effort consisting of one project after other. Publicity projects, civil defense activities, essage handling, emergency work, a friendly smile— such things improve our relations with the public. nd that precisely is what is meant by the somewhat gue-sounding term "public relations."

And continued effort is extremely important. For in is publicity-numbed age, the fellow who does one ıblic service and then stops is soon forgotten.

Our hobby is the only one we know of that is backed international treaty. (How about private flying?—Ed.) ut it won't keep such high standing if the majority people and their representatives should begin to ink our activities aren't worth while. For there are lots interests ready to move into our frequencies. Let's ntinue to show people—individually and through our ubs—that we are worthy of our high standing.

* * *

Speaking of radio clubs, quite a few have been fornate enough to obtain some kind of vehicle which they e equipping as mobile emergency communications nits. In some cases, the vehicle is self-propelled; in ther cases it is a trailer which can be hauled about by ny auto or truck which may be available in an emerency. Both ideas have merit. But the important thing to have a good portable or mobile station available.

I mention the subject because it seems not only an leal way in which amateurs can uphold their tradition nd fulfill their responsibilities—but also a relatively asy, efficient, and colorful way of doing the job.

A club communications vehicle project permits poolng the efforts, ideas and equipment of a lot of fellows nd gals. And the existence of such a vehicle in a comunity will be publicly recognized by various official nd nonofficial organizations (including the newsapers, if you will only tell them about it). It will be oncrete evidence that hams do more than engage in hat a lot of people call "silly chatter" that only ouses up Milton Berle.

One club member pointed out the big stumbling lock in such a project is acquiring the vehicle. He said he hears such things cost money. And he is so right! Well, where there's a will, there's a way.

Some of the clubs have had such vehicles donated. Luck? Maybe it was pure luck—and maybe not. Maybe a little skull practice and then a few hints in the right direction encouraged such donations. Recently the Atlanta Radio Club acquired a van truck for $1 from a local organization which preferred to remain unnamed. With all the fine brains in the fraternity, more clubs ought to be able to figure out some angles that would lead to club possession of vehicles that could serve as emergency communications units. The Atlanta Club's truck was second-hand, of course, but it came with a water storage tank, sink, icebox, stove and cabinets. The boys now are installing radio equipment.

* * *

The editor asked a question the other day that reminded me of something perhaps a lot of hams don't realize. You see, he recently moved to a spot where for the first time in his life he didn't have to bend the ends of a half-wave 80-meter antenna. The switch apparently has awed him and he asked if we thought it would be worth while putting up a long-wire on 80.

It seems his property is long but narrow. We were forced to advise him that unless he particularly wanted gain in that long direction (which he didn't) he ought not to go to any great pains to put up a long-wire. And the reason is that a long-wire gives you more losses than gains. In other words, relatively speaking, the nulls—broadside—of a long-wire probably do more damage in general coverage work than the gain off the end does good. He's still wondering what to put up—and we didn't have the heart to suggest that probably his best bet would be a vertical (which he could have put up on any old lot).

* * *

Incidentally, the editor was hopping all over us the other day asking where are all these projects we've been promising. Well, honestly, all I can say is that they are in the works. But as you know—if you've ever designed, built, and tested a piece of equipment—it takes time. And because we want to be sure there are no bugs in anything we write up—well, it takes up a little more time than usual. Especially with the Army, Navy and commercial people breathing down our back asking for *their* projects!

— Lighthouse Larry

Operation 'Bump'

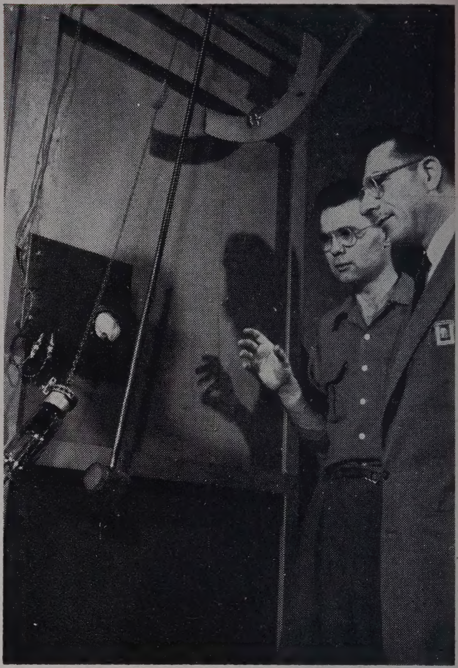
G-E HAMS TEST A GL-805

G-E electronic tubes go through a series of grueling tests. One of them, shown at right, given to some tubes, is a shock test known in the laboratory as "bumping."

At the far right in the picture L. F. Jeffrey, W2GYV, supervisor of the test laboratory and designer of the "Mobile-Marine Receiver" (G-E HAM NEWS Vol. 7, No. 4), watches A. J. Banas, W2DIS, also of the test lab staff, "bump" a popular ham tube.

The subject of the test is a GL-805, taken from the production line at G.E.'s transmitting and industrial tube plant in Schenectady. The tube is hung by the base with an adjustable clamp. Then a 2-pound weight at the end of a 4-foot rod is lifted to an angle of 25 degrees and let fly. The face of the weight is covered with rubber of a specified resiliency to avoid cracking the glass envelope of the tube. The clip-leads and meter shown are to check for shorts and filament continuity after a bump. Although W2GYV and W2DIS are wearing their safety glasses, they have never seen a G-E tube break in "Operation Bump." Of course, the objective is to test the internal structure rather than the glass.

G-E started "bumping" tubes long before such tests became common specifications in government contracts.



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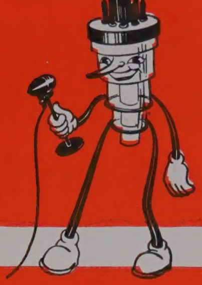
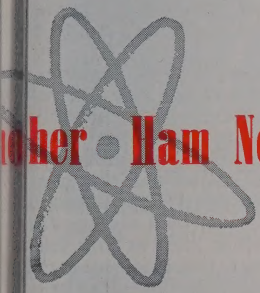


NUARY-FEBRUARY, 1954

VOL. 9—NO. 1

ABOUT POWER SUPPLIES

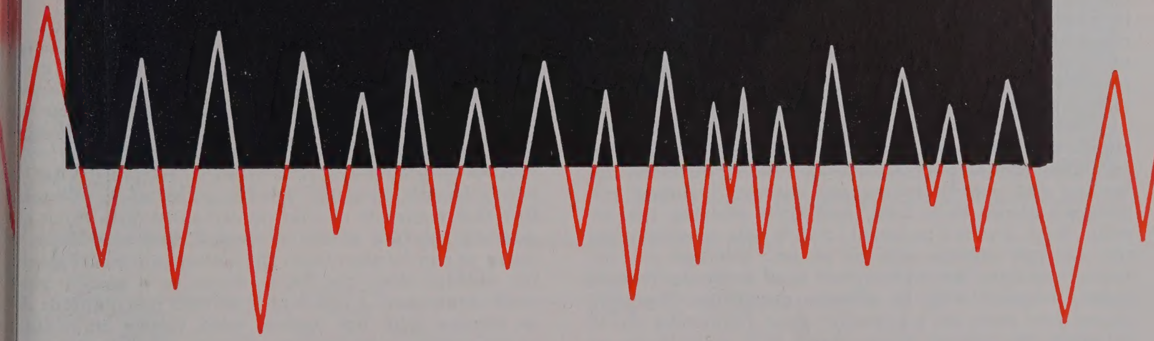
BETTER DYNAMIC CHARACTERISTICS MEAN BETTER OUTPUT ON CW, AM AND SSB



her • Ham News first

Here, for the first time, is a revealing discussion of how transient oscillations in the conventional power supply filter spoil the performance of an otherwise good rig—and what can be done to correct the difficulty.

The next issue of G-E HAM NEWS will contain design and construction specifications for 750-volt and 1500-volt supplies employing the principles discussed here.



ntents

Dynamic Characteristics of Power Supplies....page 2
TV Channel Frequencies....page 5
Designer's Corner....page 6
Sweeping the Spectrum....page 7
Trapping Transients....page 8

better dynamic characteristics mean better output on CW, AM and SS

What is dynamic regulation in a power supply? Because the literature in this field is exceedingly sparse, perhaps a good way to start is to take two common definitions and directly relate them to the subject at hand, thus:

Static—Relating to forces in equilibrium (as d-c plate voltage and current in a rig transmitting a continuous unmodulated carrier).

Dynamic—Relating to moving forces (as d-c plate voltage and current under typical operating conditions in the average amateur CW, AM or SSB rig).

Keeping these definitions in mind will help in understanding just what goes on inside the conventional plate power supply which ordinarily consists of a center-tapped step-up transformer, rectifier tubes, and a two-section choke-input filter to reduce ripple. Since such supplies have been used since the introduction of the mercury-vapor rectifier, one might think that just about all the "bugs" would have been smoked out by now. Well, many bugs have been eliminated and, as a consequence, manufacturers of transformers and chokes now proudly offer what they term "matched power supplies"—sets of components for which they publish ratings, voltage regulation curves, and ripple output to be expected. These "matched" components make up power supplies that do perform as the published data indicates.

LOSS OF VOLTAGE

However, poor *dynamic* regulation in these conventional power supplies means distortion of signal output—alteration of actual radiated intelligence—almost without exception in CW, AM and SSB rigs. These faults exist no matter how good a *static* regulation figure is indicated by d-c input instrumentation. This comes about in the conventional power supply because transient oscillations excited in the filter rob the rig of voltage during a sizable portion of the time it is sorely needed. Hams who light-heartedly pass this effect off as "instantaneous," thereby implying it is of no consequence, may want to examine their power supplies more critically after studying the test data presented below.

Consider the meaning of the voltage regulation curve usually given for the ordinary rectifier-filter combination. This is a "static" curve, obtained by loading the supply to certain currents, reading the voltages across each load, and then plotting the results. Such a curve is useful, but it tells us only what the *average* voltage will be at any *average* current value—*because the instruments used to measure these values respond only to average quantities.* Figure 1 shows just such an acceptably good regulation curve in which the voltage drops about 10% or so from no load to full load on an *average* basis.

But is it the average load, voltage and current alone that we are interested in? What kind of loads do our amateur transmitters present to their respective power supplies? Do we transmit intelligence with average loads—or with a complex pattern of instantaneous loads?

VOLTMETERS MISLEADING

Consider the final stage of a CW transmitter. key-up the load is zero, or, at most, a rather small or When the key is closed, the maximum load current drawn. Now does the power supply follow the sa curve that was plotted under static or slowly varyi loads? An ordinary voltmeter might lead one to thi so.

But look at Figure 2! This is a photograph of cathode-ray oscilloscope which shows how the volta varies with time in the ordinary power supply wh the load is suddenly applied as in keying a CW r The solid upper line shows the no-load output of t supply—820 volts; the lower solid line represents ze volts. The lower waving line is a 60-cycle timing wa which permits reading the actual load voltage (repr sented by the upper oscillating line) at any fracti of a second from the instant the load was applie The spot on the oscilloscope was started as the k closed to a 200-milliampere load. (The steady curre rating on the test supply is 250 milliamperes.)

Note how the load voltage dips suddenly to less th a third of the no-load voltage line, then wildly ov shoots the line and oscillates about until it final settles down to the average loaded voltage of 7 volts—which is the same as the static loaded outp voltage shown in the curve of Figure 1 for a 20 milliampere load.

(Incidentally, the ripple under load is visible on t right-hand portion of the load voltage curve of Figu 2, but is fairly small compared with the extravaga excursion of the voltage in the period immediate following the application of the load.)

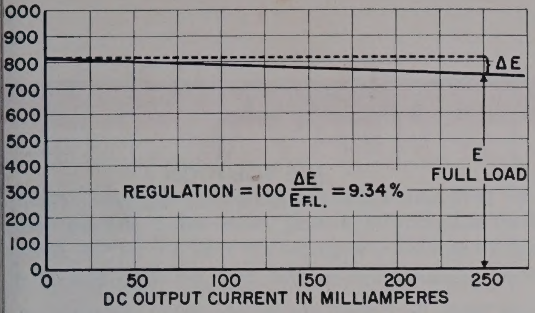
A d-c voltmeter that was connected across the li at the same time merely dropped from 820 to 760 vo and gave no indication of the actual turmoil imme ately after keying!

EFFECT ON CW OPERATION

Is this turmoil anything to worry about? Well, t final stage in a CW transmitter generally runs Class and the transient oscillation shown across the pow supply modulates each character with that same wa form quite independently of any keying filter that m be provided for click reduction. This, then, is the sign envelope—somewhat poorer than ideal!

How long is a dot or a dash in seconds? That d pends on the operator for the most part, of cour But this transient oscillation certainly lasts for a co siderable portion of the average CW dot or dash, b cause as can be seen from the timing wave of Figure the voltage does not settle down to a steady ripp until more than a tenth of a second has elapsed. A as anyone who has played with timing in radio photography work knows, a tenth of a second is from what is normally thought of as "instantaneou

When the load is removed (key up), the pow supply voltage behaves as photographed in Figure 3 another wild peak, with the oscillation finally settli down to the no-load line. Of course, in this case th is no "on the air" effect, but the filter condensers a all other connected equipment are subjected or



G. 1 *Static regulation curve (C_a, C_b any value)*

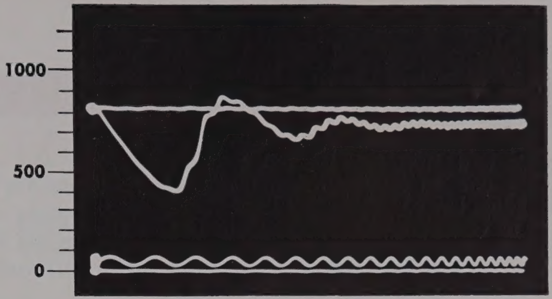


FIG. 5 *Load applied (C_a=0; C_b=10 mfd)*

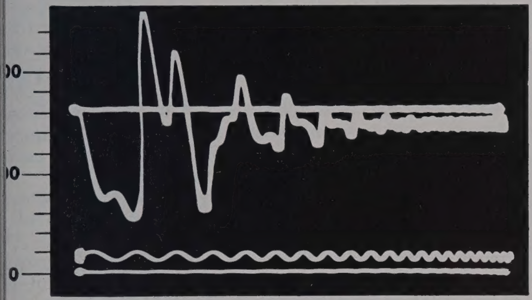


FIG. 2 *Load applied (C_a=C_b=2 mfd)*

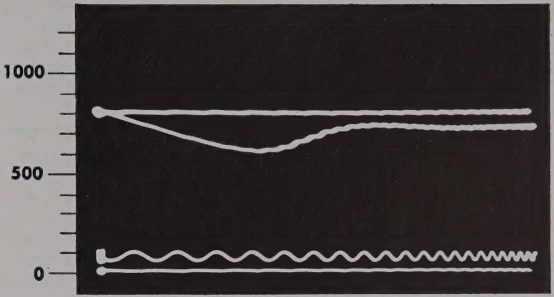


FIG. 6 *Load applied (C_a=0; C_b=45 mfd)*

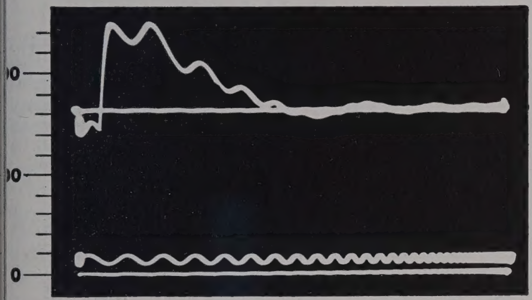


FIG. 3 *Load removed (C_a=C_b=2 mfd)*

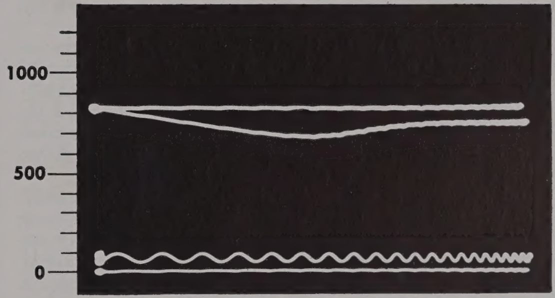


FIG. 7 *Load applied (C_a=0; C_b=90 mfd)*

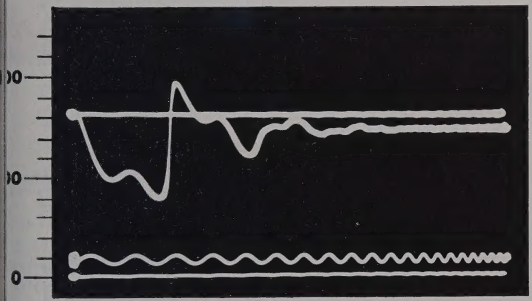


FIG. 4 *Load applied (C_a=C_b=5 mfd)*

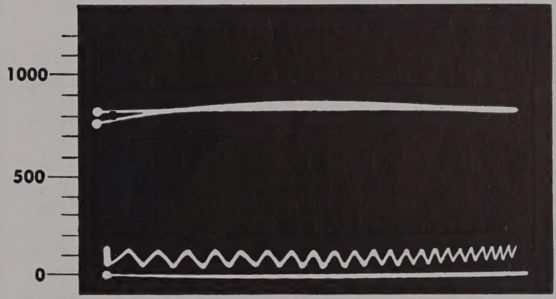
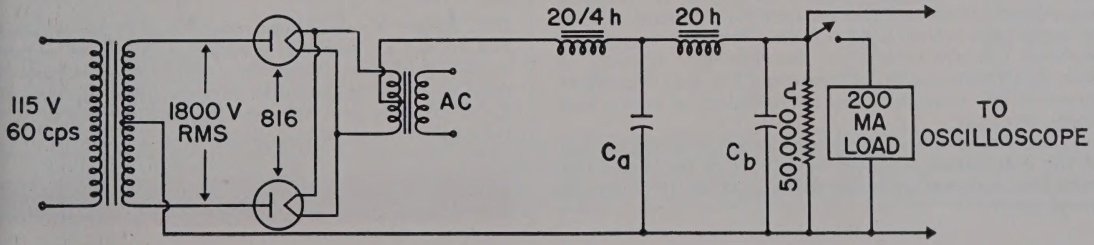


FIG. 8 *Load removed (C_a=0; C_b=90 mfd)*

Above data taken with this 750 V/250 ma d-c supply (see text):


115 V
60 cps
1800 V
RMS
816
AC
20/4 h
20 h
C_a
C_b
50,000 Ω
200
MA
LOAD
TO
OSCILLOSCOPE

again to this voltage turmoil. This may explain why every once in a while a ham's whole rig is blown to kingdom come when he shuts it off.

The oscillograms shown apply only to single keying actions. Fast keying conditions intensify the transients shown in Figures 2 and 3.

EFFECT ON PHONE OPERATION

So much for CW loads on the common garden variety power supply. Now before the phone men start laughing up their sleeves at their brass-pounding brethren with "hand-modulated" rigs, let's take a close look at Class AB_1, AB_2, and B modulators operated with conventional power supplies.

It is characteristic of these modes of operation to draw average plate current which is a function of the modulating signal. Thus, the modulator load is similar to the on-off type of load experienced in a keyed CW transmitter, and the power supply transient so induced can be a real hazard to good quality. Because of the relatively sluggish action of a d-c plate current instrument (which tends to indicate current flow averaged over about half a second or so) the actual cyclic or syllabic transient load presented to the power supply is much greater than one would be led to believe by just reading the plate milliammeter.

What happens when the power supply behaves as in Figure 1? The answer is high distortion and loss of required peak power because most of the supply voltage just is not there part of the time it is needed by the modulator, and so the modulator tubes cannot draw the peaks of plate current that the grid drive on the modulator stage says should be drawn.

And remember, distortion tests made with steady tones will not show this "dynamic" distortion because the drain on a power supply induced by a steady tone is constant when averaged over one-half of the period of the test tone wave—relatively short compared to a filter transient which lasts more than a tenth of a second.

EFFECT ON SSB OPERATION

Single-sideband transmitters employing Class AB_1, AB_2, or B RF stages present the same type of load to their respective power supplies—and, as a result, also introduce considerable distortion in the radiated signal.

About the only types of emission in common use which do not suffer "on the air" losses as a result of transient filter oscillations are NBFM and FSK. (No transients are excited in the filter because the load is steady.) Linear amplifiers used with AM signals overcome this dynamic power supply regulation problem, but the carrier efficiency of this mode of operation is so low that use of linear amplifiers in amateur AM transmitters is not common. Similarly, constant current (or Heising) modulation for AM is another case where dynamic power supply regulation is not of primary importance. Grid modulation systems—control, screen or suppressor—also side-step the dynamic regulation problem but are inherently low-efficiency systems at best. In all these modes of operation, the only important power supply considerations are adequacy of rating and ripple filtering.

What can be done to improve the dynamic regulation of the conventional power supply? Let us follow the steps that were taken in the shack of W2KUJ to attack the problem.

THE SOLUTION

It became apparent that merely improving the rip
attenuation by adding more filter sections affec
the dynamic regulation very little. So the first s
was to increase the capacity of the existing filter fr
2 microfarads to 5 microfarads per capacitor. The res
appears in Figure 4—which shows excellent rip
filtering but only slightly reduced voltage excursi
as compared with the transient of Figure 2.

Next, the two 5-microfarad capacitors of the t
section filter were connected in parallel to make
single-section filter (with the two chokes left in seri
As shown in Figure 5, the voltage excursions are
greatly changed in magnitude, but have a less comp
pattern—comparable, in fact, to that of a simple dam
oscillation. But here again, the oscillation is exci
in the filter by the suddenly-applied load.

The next step in the test was to use 45 microfar
of capacity as the final element of the filter. The
namic regulation performance responded nicely,
shown in Figure 6. Note the reduction of magnit
of voltage swing and lowering of the resonant freque
of the filter as compared with Figures 2, 4 and 5.

FINAL DESIGN

This encouraged a final design in which 90 mic
farads of capacity rendered the curve shown in Fig
7. Here the dynamic regulation is just slightly grea
than the static regulation, which, incidentally, measu
9.34%—quite good enough for almost any amat
transmitter. The "break" characteristics of this fi
design are pictured in Figure 8. Use of more capac
would improve the dynamic characteristics of
power supply correspondingly because the reson
frequency of the filter would be lowered even farth
(For more detailed theory on the dynamic charact
istics of plate power supplies see "Designer's Corne
page 6.)

USING FLUORESCENT TUBE AS TUNING INDICATOR

A sure indicator of maximum RF in your anten
is a fluorescent tube placed in the antenna field. T
tube can be taped right to the antenna at the volta
node. Thus in tuning the final or the antenna coup
maximum input is indicated when the light is brighte
This is particularly convenient when your antenna
located in such a position that it can be seen from
window of the shack. The stunt helps especially wh
using a pi-network in the tank circuit without a coupl

—S. BAXTER, VE7H

(*Ed. Note*—No doubt the neighbors will be confused
end to see an antenna winking at them at about
wpm—until they suddenly tumble to the fact th
may be some relationship between that blinking lig
up in the sky and the tweedy look their TV pictu
tube takes on at certain times.)

TV CHANNEL FREQUENCIES

Hams frequently have occasion to refer to TV frequencies and the following list is reprinted for reference. The list includes both picture and sound carrier frequencies in each of the 12 VHF TV ranges and the 70 UHF TV ranges. More and more of these channels are coming into use in the smaller communities throughout the country.

CHANNEL NO.	FREQUENCY RANGE MC	PICTURE CARRIER MC	SOUND CARRIER MC
2	54–60	55.25	59.75
3	60–66	61.25	65.75
4	66–72	67.25	71.75
5	76–82	77.25	81.75
6	82–88	83.25	87.75
7	174–180	175.25	179.75
8	180–186	181.25	185.75
9	186–192	187.25	191.75
10	192–198	193.25	197.75
11	198–204	199.25	203.75
12	204–210	205.25	209.75
13	210–216	211.25	215.75
14	470–476	471.25	475.75
15	476–482	477.25	481.75
16	482–488	483.25	487.75
17	488–494	489.25	493.75
18	494–500	495.25	499.75
19	500–506	501.25	505.75
20	506–512	507.25	511.75
21	512–518	513.25	517.75
22	518–524	519.25	523.75
23	524–530	525.25	529.75
24	530–536	531.25	535.75
25	536–542	537.25	541.75
26	542–548	543.25	547.75
27	548–554	549.25	553.75
28	554–560	555.25	559.75
29	560–566	561.25	565.75
30	566–572	567.25	571.75
31	572–578	573.25	577.75
32	578–584	579.25	583.75
33	584–590	585.25	589.75
34	590–596	591.25	595.75
35	596–602	597.25	601.75
36	602–608	603.25	607.75
37	608–614	609.25	613.75
38	614–620	615.25	619.75
39	620–626	621.25	625.75
40	626–632	627.25	631.75
41	632–638	633.25	637.75
42	638–644	639.25	643.75
43	644–650	645.25	649.75
44	650–656	651.25	655.75
45	656–662	657.25	661.75
46	662–668	663.25	667.75
47	668–674	669.25	673.75
48	674–680	675.25	679.75
49	680–686	681.25	685.75
50	686–692	687.25	691.75
51	692–698	693.25	697.75
52	698–704	699.25	703.75
53	704–710	705.25	709.75
54	710–716	711.25	715.75
55	716–722	717.25	721.75
56	722–728	723.25	727.75
57	728–734	729.25	733.75
58	734–740	735.25	739.75
59	740–746	741.25	745.75
60	746–752	747.25	751.75
61	752–758	753.25	757.75
62	758–764	759.25	763.75
63	764–770	765.25	769.75
64	770–776	771.25	775.75
65	776–782	777.25	781.75
66	782–788	783.25	787.75
67	788–794	789.25	793.75
68	794–800	795.25	799.75
69	800–806	801.25	805.75
70	806–812	807.25	811.75
71	812–818	813.25	817.75
72	818–824	819.25	823.75
73	824–830	825.25	829.75
74	830–836	831.25	835.75
75	836–842	837.25	841.75
76	842–848	843.25	847.75
77	848–854	849.25	853.75
78	854–860	855.25	859.75
79	860–866	861.25	865.75
80	866–872	867.25	871.75
81	872–878	873.25	877.75
82	878–884	879.25	883.75
83	884–890	885.25	889.75

Designer's CORNER

Some time ago when checking out my SSB transmitter I ran into a dismaying situation.

Checks with a steady audio tone showed the rig was putting out all that could be asked for. But voice peaks measured on the oscilloscope would not come anywhere near the same level. The cause was not easy to determine, but it finally turned out to be tremendous voltage drops in the power supply during a considerable portion of each syllable as a result of filter oscillations. In a more recent test I actually photographed these voltage drops, as pictured in the foregoing article.

The problem is one which involves effective damping of filter resonance or reducing the coupling between the load variations and the resonant system of filter chokes and capacitors—or both—without sacrificing efficiency or static regulation, and without overloading the rectifier tubes or any other power supply component. All this must be done without increasing the cost of the final design appreciably over that of the conventional power supply. It sounds a lot like "eating your cake and having it too," since what we have seen in the oscillograms of Figures 2, 3, 4 and 5 is commonly accepted although rarely suspected performance.

THE SOLUTION

The practical solution of the filter resonance problem involves these basic steps:

1. Reducing the Q of the filter without increasing its series resistance, and
2. Increasing the energy storage in the last filter element.

The first step could be achieved by shunting capacitors and chokes with resistors, but if this is done the peak current handled by the rectifiers would go up, the static regulation would be poorer, and a great deal of power would be wasted in the damping resistors—that is, the efficiency of the power supply would be low.

Since the Q of the choke is $\frac{X_L,}{R}$ where X_L is the inductive reactance at a given frequency, and R is the effective series resistance of the choke at the frequency considered, and since the Q of the filter is equal to the Q of the choke (if the capacitor has relatively little effective series resistance), Q can be lowered by decreasing X_L or increasing R. If R is increased the static regulation will suffer as a consequence, so the approach should be through decreased X_L. Since $X_L = 2\pi f L$ a low product of $f \times L$ is desired. In the interest of efficiency and static regulation, practical limits are placed on the value of L, the inductance of the choke, so the factor f is the only one left to be altered.

NEED LOWER FILTER Q

What determines f? The resonant frequency of the filter is the quantity f in question. To a first approximation, $f = \frac{1}{2\pi LC,}$ where C is the capacity of the filter condenser with which L resonates. Therefore, the Q of the filter can be lowered by increasing C, and this helps in attainment of the second basic step listed above.

What would have happened if L had been increased by a factor of 9, instead of increasing C by the same factor? The resonant frequency would have been lowered as much, but the series resistance probably would increase by about the same factor (it certainly would if 9 times the number of identical chokes had been used) and the static regulation would be nine times that indicated by Figures 1, 2, 4, 5, 6, and 7, o 84%, a drop from 820 volts, no load, to 131 volts a 200 MA load! The Q would be the same in the filter but the total performance would be so sadly degraded that such a supply would be valueless except for salvag of parts.

In some cases, the best design would be one in which both the chokes and the condensers were increased in value until suitable dynamic performance was obtained. In high-voltage supplies this begins to pay dividends since the "critical"[1] inductance increase with voltage for a given minimum or bleeder curren drain, and high-voltage capacitors begin to get expensive. Static regulation depends on the DC resistanc of the chokes (together with the equivalent serie resistance due to the plate transformer) but a give total equivalent resistance in the chokes and transformer yields less *percentage* voltage drop as the operating voltage is increased.

TWO POWER SUPPLY DESIGNS

We have designed two power supplies which promis to provide excellent dynamic regulation, good stati regulation and good ripple filtering. Best of all, thes supplies are not expensive ones. The first supply ha a continuous rating of 750 volts/250 MA output fo moderate and low power applications, while the secon is rated at 1500 volts/250 MA. One nice thing about i all is that the builder may utilize the principle we hav explained and proven in order to build other supplie which exhibit equally good (or better) dynamic regulation. Either power supply is ideally suited for CW transmitters, Class B modulators, linear amplifie (such as the Lazy Linear[2] or the Power Peaker[3]), o any application where the voltage and average curren requirements are within the ratings given. The fina samples of these two power supplies were not completed by the time this issue of G-E HAM NEW went to press, but construction details will be give in the March-April issue.

—*W2KU*

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[1] See G-E HAM NEWS Volume 7, No. 2, page 6; also, th ARRL Handbook. In these treatments only static regulation considered. Good background material, though.

[2] G-E HAM NEWS Volume 4, No. 4

[3] G-E HAM NEWS Volume 7, No. 5

HOW TO GET G-E HAM NEWS

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SWEEPING *the* SPECTRUM

eems like one thing that plagues most hams is a petual list of unfinished projects. Perhaps it's tly a general failing of the human race to bite off e than can be chewed. But as far as hams go, a lot he trouble comes from what we might call "over-husiasm." In the field of ham radio there are so ny things to do, so many types of equipment that be built.

ut one of the fellows here dropped a comment a le ago which can help keep down the number of nished projects—by keeping down the list of projs. We had asked him if he would like to see an cle published on a certain piece of equipment and shot right back at us: "What would I use it for? on't keep anything in the shack I don't use."

hat's an admirable policy, we thought. We made a w Year's resolution and that night cleaned house. d we found that we get along very nicely without old junk.

⁂

ne of the nicest things about ham radio is the diness of the fraternity to jump in and help whenr and wherever help is needed. And we don't mean physical emergencies—we mean spiritual emercies, too. As an example, the editor was telling us other day how each member of the Northern N. J. dio Association (W2DAY) sent a QSL card to a al lad who was afflicted with cerebral palsy. The erest that these total strangers seemed to show in life perked the boy up, and his folks got him a nmunications receiver. Then the hams began to ntion the lad's name frequently in their local rag ws. He became an avid SWL, a silent member of local networks—and still hopes some day to be able get his ticket. Incidentally, he's still collecting QSL ds and if anyone wants to send him one, he'd sure preciate it. Here's the QTH: Richard Ernst, 242 ales Avenue, River Edge, New Jersey.

⁂

A handy tip for both mobilers and fixed stations to ep in mind comes via "Zero Beat," bulletin of the ovidence (R. I.) Radio Association: If called upon report an accident along an unfamiliar stretch of ghway, the location can be pinpointed by reporting e number on the nearest utility pole. . . . "Zero at" also expresses amazement at the things you hear 2 meters. One Sunday a.m. this mail was read: ake 3 cups loose cranberries, 1½ cups raisins, 1 cup gar, 2 tbls flour, ½ cup water, and a pinch of salt good luck. Boil until cranberries pop, pour into pie ell, cover with strips of dough and bake." Neither ero Beat" nor G-E HAM NEWS assumes any sponsibility. . . . "Sparks," published by the Tri-ate ARA at Evansville, Indiana, reports a 3-kw generator has been *donated* to the club by a local electric company.

⁂

"Ham Hum," bulletin of the Ak-Sar-Ben RC of Omaha (W0EQU), passes on this idea: Shim up the front of the receiver and transmitter with a length of 2 x 4 shaped and painted to match the equipment. They say it makes the dials and meters more readable and gives the equipment a novel appearance. . . . The mobile section of the Michiana ARC (W9AB) has been engaging in a community service which may be of interest to others—parade duty. They patrol local parades, aiding in keeping the parade units spaced and providing LL hook-ups when emergencies or other unforeseen problems arise, according to the club bulletin, "Marc Sparks."

⁂

W5KNY passes on a mobile noise reduction idea which he apparently got from W5DAS: Provide both the auto BC set and the converter with a hot A lead direct from the battery—a lead with a well-grounded shield. They say this can take off a good thick layer of mobile noise. . . . A TV serviceman in California has come up with a stunt that helps in tracking down an intermittent failure. He uses an infrared heat lamp to bring a benched chassis up to its normal in-the-cabinet operating temperature. This stunt is reported in the current issue of "Techni-Talk," our Tube Department publication for TV servicemen—available to them through authorized G-E tube distributors.

⁂

It's reported K0WBF is maintaining a constant daytime watch on 3983 kc for any "CQ Omaha" in anticipation of communications emergencies in these months of snow, sleet and ice. . . . The Detroit Amateur Radio Association (W8ZZ) has been hashing over the problems involved in delivering traffic from boys overseas asking their folks to send some money. When the citizen who doesn't know much, if anything, about ham radio, gets a message that his or her boy wants money—well, it often leads to misunderstanding and suspicion. Some hams now refuse to handle such traffic; others feel that all traffic must be handled. In any event, delivering such a message by phone is a ticklish problem. Those called upon to telephone such messages are cautioned to think out carefully beforehand just how to answer the inevitable questioning of the addressee. The boys who have had trouble say it can be worse than handling a TVI complaint!

—*Lighthouse Larry*

Trapping Transients

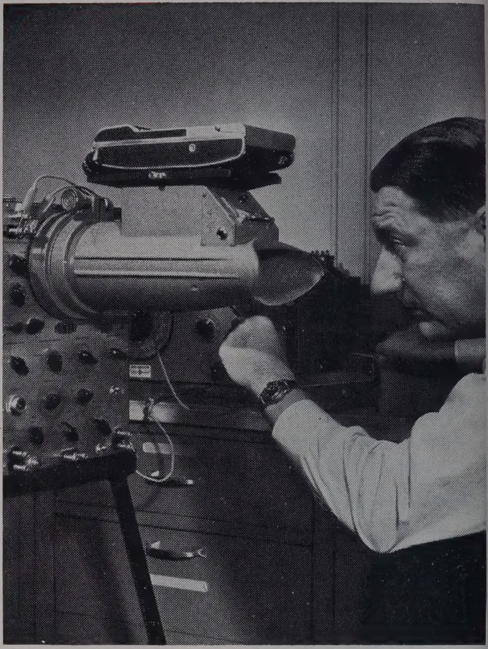
HOW TO PHOTOGRAPH VOLTAGE DROPS

The oscillograms shown on page 3 of this issue of G-E HAM NEWS were taken with a 5-inch cathode-ray oscilloscope fitted with an oscillograph camera. In this photograph Don Norgaard, W2KUJ, is shown just before he opens the shutter of the camera and applies the load to a power supply he is testing for dynamic regulation.

The power supply output voltage is fed to the vertical deflection plates of the oscilloscope through a voltage divider while a single horizontal sweep is started by the same switch that applies the load to the power supply. The load, incidentally, was a vacuum tube biased to cut off for no-load conditions and made to take load by controlling the grid voltage with the switch. This type of load simulated the load applied to a power supply feeding a keyed stage in a transmitter.

On one occasion the transient voltage developed in the power supply was so high that the multiplier resistor of a voltmeter reading the output voltage of the supply under test arced across and burned out the meter. That time the voltmeter *did* give some indication of the turmoil in the power supply following a suddenly applied load!

Don has been a regular contributor to G-E HAM NEWS and has been responsible for the design of the *Harmoniker*, the *Lazy Linear*, the *Signal Slicer*, the *SSB, Jr.*, and other pieces of ham gear described in G-E HAM NEWS.



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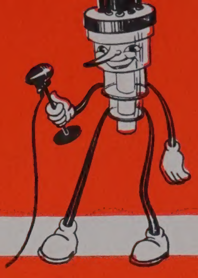
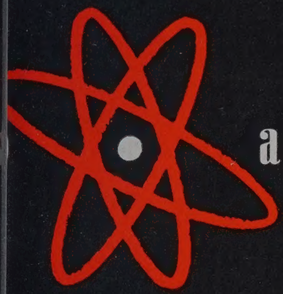


MORE ABOUT POWER SUPPLIES

TWO 250 MA PLATE POWER SUPPLIES WITH EXCELLENT DYNAMIC CHARACTERISTICS

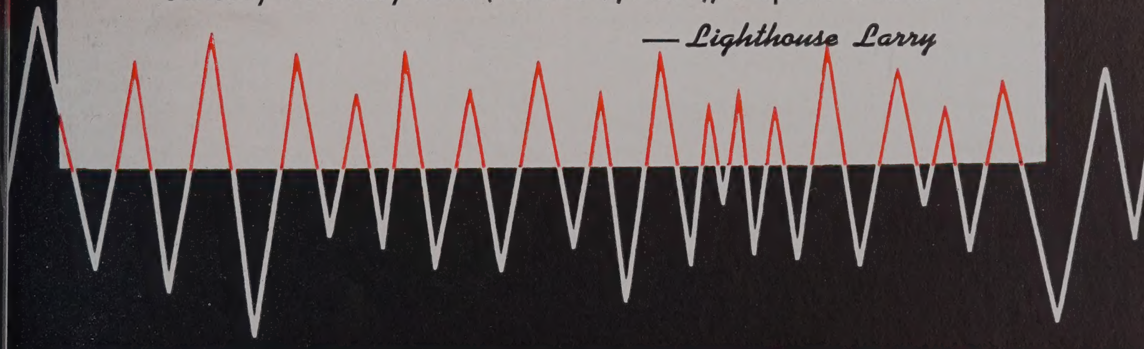


a power control unit

In the previous issue of G-E HAM NEWS we presented a discussion of the dynamic characteristics of plate power supplies ordinarily used with amateur transmitters and modulators—together with some design notes on how to improve said dynamic characteristics.

Here are two power supplies designed and constructed in such a way as to not only obtain unusually good dynamic regulation but also to keep cost to a minimum. To fully appreciate these two designs, we suggest you review the previous article. If you can't beg or borrow a copy of our January–February issue (Volume 9, No. 1), drop me a card.

—*Lighthouse Larry*



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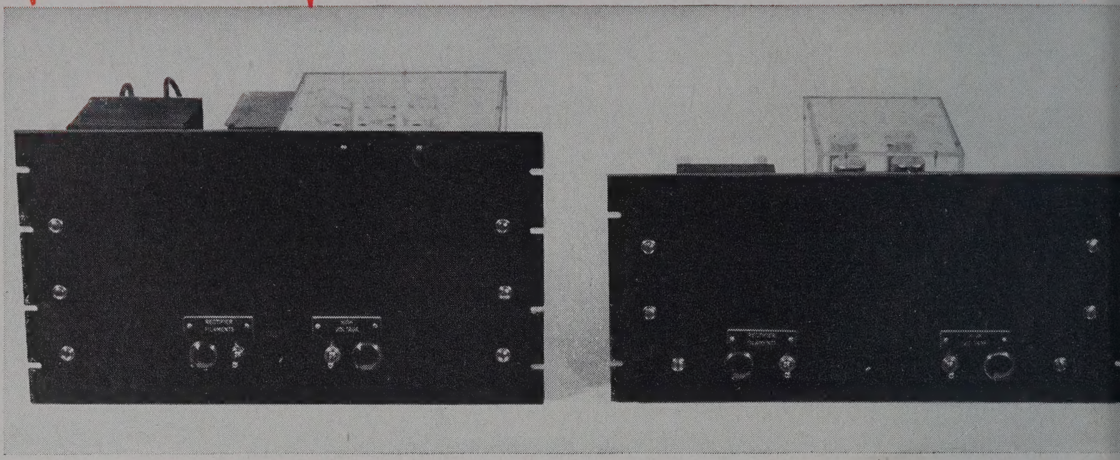
two power supplies



1500 VOLT

750 VOLT

The dynamic characteristics of the average amateur power supply are those characteristics which become apparent in the operation of the supply when it is in actual use under average amateur operating conditions. In most amateur operations this means rapid intermittent application and removal of widely varying loads.

Meters will not measure the extensive voltage drops and peaks which are induced by varying the load—and as a result it has become somewhat traditional to regard such voltage excursions as "instantaneous" and "of little consequence."

However, as demonstrated in the tests reported in the last issue of G-E HAM NEWS, these voltage excursions are somewhat more serious than is generally believed. The oscillograms showed that when normal load is applied d-c output voltage will drop to as low as a third of the no-load voltage, then wildly overshoot the no-load level, drop again, and so on—even in a power supply which has an acceptable static regulation figure.

Instantaneous oscillations? That depends on the definition of the word *instantaneous.* As these oscillations were actually photographed on an oscilloscope along with a 60-cycle timing wave, it was shown that the transient oscillations lasted well over a tenth of a second—enough time to competently modulate every CW character and distort at least a fair portion of the first syllable of every word a phone man utters.

Experiments showed the oscillations were directly related to the resonant frequency of the power supply filter—and that the simplest solution to the problem was to lower the resonant frequency by adding capacity to the filter. It was found that addition of sufficient capacity would smooth out the dynamic regulation curve so that it would nearly coincide with the conventional static regulation curve of the supply.

However, high-voltage oil capacitors cost money—lots of it. In order to economize, at least in the sense of
not running these newly designed power supplie
great deal higher in cost than conventional supplie
the same ratings, electrolytic capacitors have b
specified in series-parallel combinations together w
voltage-equalizing resistors.

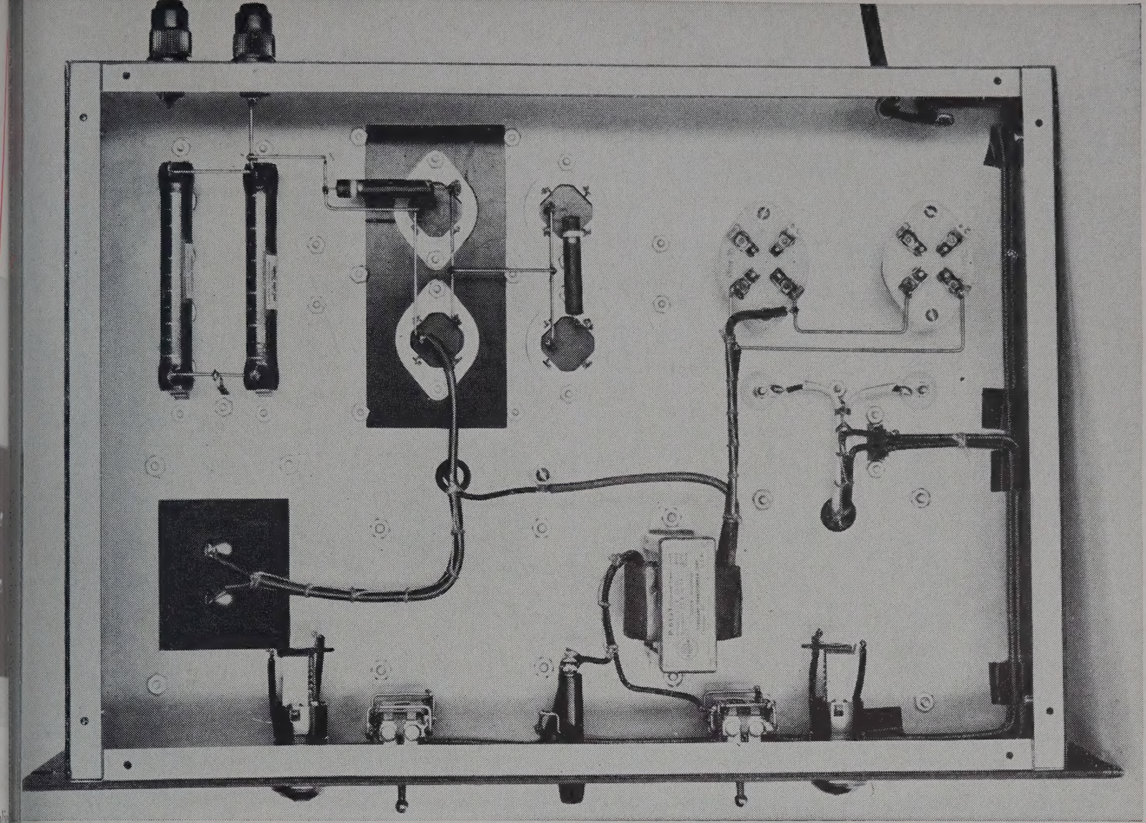
Electrolytic capacitors generally are, we belie
better than they are cracked up to be in amat
circles. True, they may not last as long as oil capacito
but as they have been improved considerably si
first introduced, it was felt they were well worth tryi
Those who still feel squeamish about using electroly
may, of course, put in oil capacitors of the same va
with equally good results. However, it is felt the el
trolytics offer more capacity per year, per dollar.

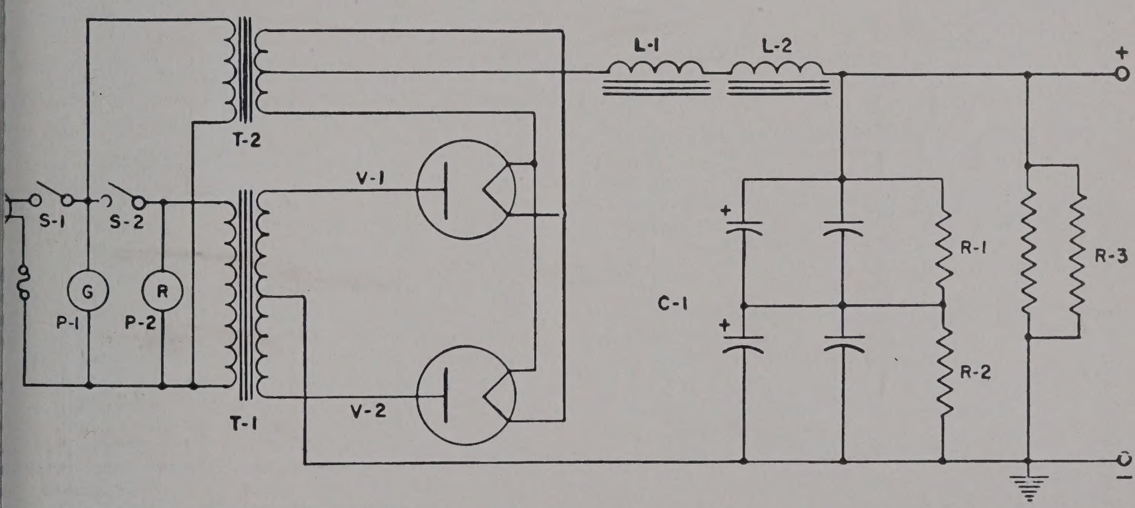
In obtaining the unusually high capacity via
series-parallel methods shown in the circuit diagra
it is important to make sure that all the equaliz
resistors are used. This will insure operation of e
capacitor well within its voltage rating.

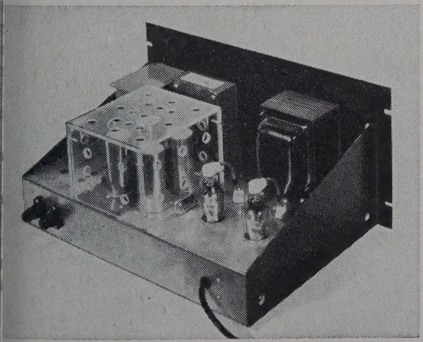
The can of each electrolytic capacitor is its negat
terminal. The capacitors in the series arrangement
the negative (chassis) end of the string may be moun
directly on the chassis with the metal mounting ri
supplied with each capacitor. However, the remain
capacitors must be installed with cans insulated
only from the chassis but also insulated from the c
of the capacitors higher up in the string. Careful
amination of the circuit diagrams will make this cl

To provide this insulation a variety of mount
methods will suggest themselves to the builder.
method shown here is to mount capacitors that m
be insulated on a piece of textolite which in turn
mounted in a hole of appropriate size cut in the chas

In addition, it is strongly recommended that
shield be placed over those capacitors whose c
operate above ground. *This shield is to protect*
operator—not the capacitors! Remember that the
of an electrolytic capacitor is generally thought of, s
consciously, as being grounded. The builder may h

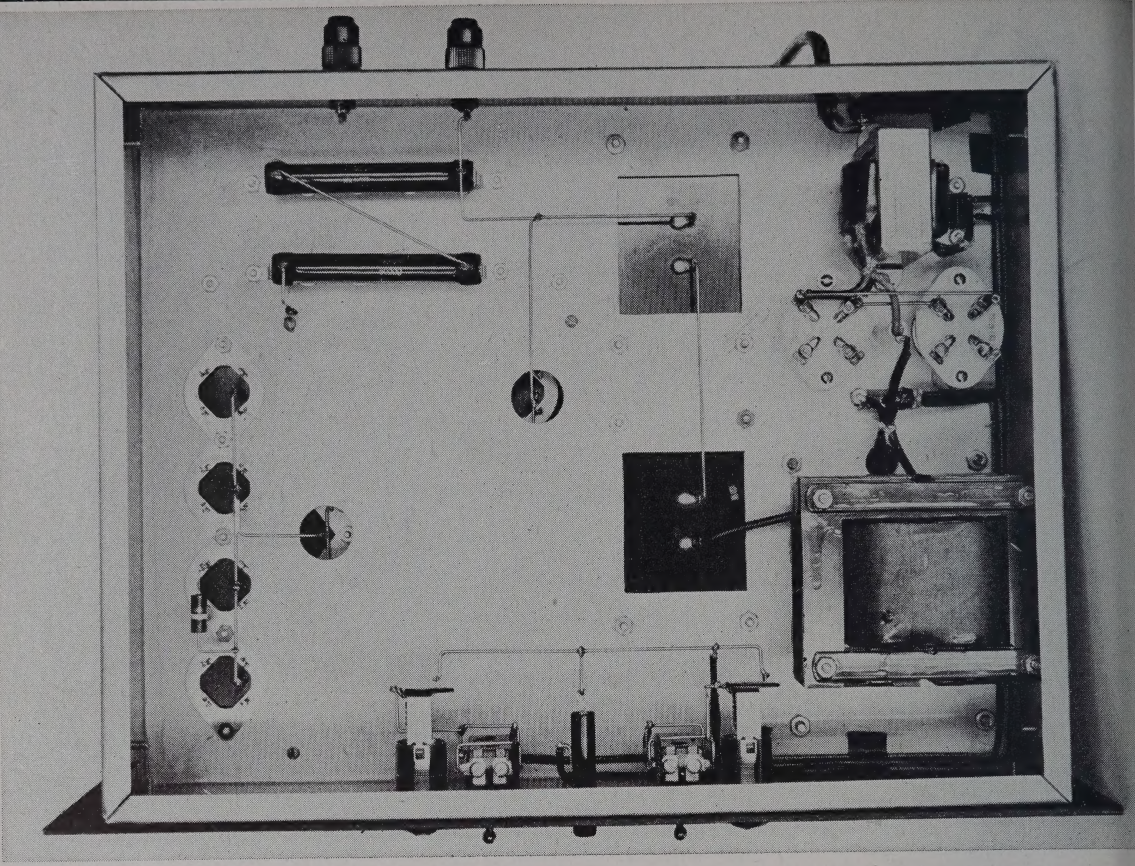


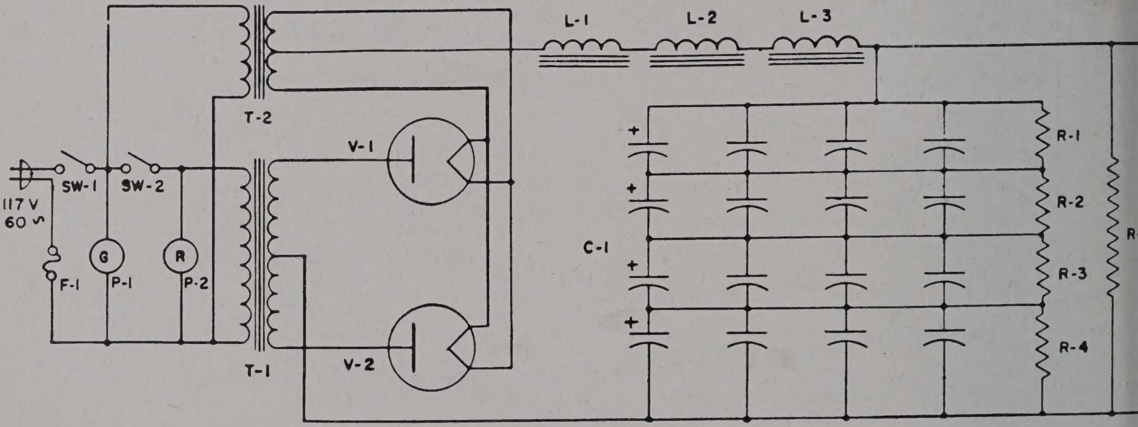




750 v/250 ma Power Supply

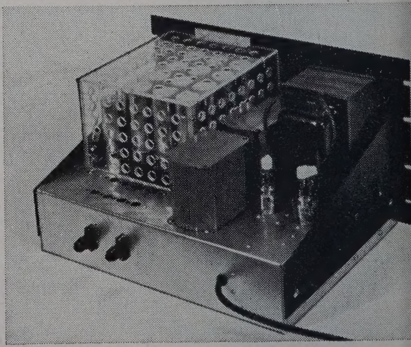
S_1, S_2—SPST toggle switch (preferably power type, 12A)
T_1—920-0-920 plate transformer (Stancor PC-8305)
T_2—2.5 v, 5A filament transformer (Stancor P-6133)
V_1, V_2—GL-816
L_1—20/4 h at 30/300 ma, 80 ohms D-C resistance swinging choke (Stancor C-1720)
L_2—20 h, 225 ma smoothing choke (UTC S-31)
C_1—125 or 90 mfd (4 Sprague TVL-1760 or 1850)
R_1, R_2—200,000 ohms, 2 w composition
R_3—50,000 ohms, 25 w (see text)
P_1, P_2—110 v pilot lamp
F_1—5A slow-blowing fuse




L-1
L-2
L-3
T-2
V-1
SW-1
SW-2
117 V
60 ∿
F-1
G
P-1
R
P-2
C-1
+
+
+
+
R-1
R-2
R-3
R-4
R
T-1
V-2

1500 v/250 ma Power Supply

S_1, S_2—SPST toggle switch (power type, 12A)
T_1—1790-0-1790 plate transformer (Stancor PT-8314)
T_2—2.5 v 5A filament transformer (Stancor P-6133)
V_1, V_2—GL-816
L_1—20/4 h at 30/300 ma, 80 ohms D-C resistance swinging choke (Stancor C-1720)
L_2, L_3—20 h, 225 ma smoothing choke (UTC S-31)
C_1—125 or 90 mfd (16 Sprague TVL-1760 or 1850)
R_1, R_2, R_3, R_4—100,000 ohms, 2 w composition
R_5—100,000 ohms, 50 w (see text)
P_1, P_2—110 v pilot lamp
F_1—10A slow-blowing fuse



danger fresh in his mind while he is constructing
power supply and for a relatively short time there-
er. But will he remember, say, a year from now when
opens the rig to service some component that some
those cans are well above ground? And will a visitor
the shack—or the junior operator—inquisitively
xing around inside the supply, ever know—*even*
er he touches one—that those cans are "hot"?

Take no chances! Time and effort taken *now* to
ld a shield for these above-ground cans can save a
in the future. The shields shown were fashioned out
sheets of plexiglass drilled with ventilation holes.
ch refinement is not necessary, of course. Shields can
fabricated from almost any type of metal. Hardware
th is inexpensive, easy to handle and when corner
nts are soldered it makes a fairly solid shield.

While the sixteen capacitors in the 1500-volt supply
y seem like a staggering number, this amounts only
a bank of four-by-four which can occupy as little
ace as an eight-inch square. Actually, of course, only
of these have to be insulated from the chassis.

Remember, the more output capacity, the better
dynamic performance of the power supply will be.
possible, it will be best to use the 125-microfarad
pacitors (Sprague TVL 1760, or equivalent). As
monstrated in the previous article, it is difficult to
how one can get too much capacity built into the
wer supply.

On the other hand, it is important not to overdo the
luctance, since the static regulation is proportional
the total d-c resistance of the chokes.

A word about the fact that 225-milliampere smooth-
chokes are here used in 250-milliampere power
pplies. In a search for chokes of the lowest possible
st and d-c resistance, the design work proceeded on
assumption that the published rating meant, in
ect, that this choke has 20 henries inductance at a
5-milliampere load—and might very likely carry
ditional current. As a test, three of these chokes
re put under continuous 250-milliampere loads for
hours with no adverse effects. Few amateurs run
eir power supplies at the so-called "maximum"
tings, but those who regardless of the foregoing wish
put in chokes of higher current rating and are willing
pay the additional cost can do so. The chokes
ecified in the accompanying circuits were chosen
th this in mind—that is, to get as high inductance
d as low resistance as possible at the lowest possible
st. If other chokes than those specified are used, the
sistance should be checked.

A word about the bleeder resistors used in these two
wer supplies. To run the resistors as cool as possible,
ovide a maximum of safety and save space, two
ethods were tried. In the smaller supply, two 100,000-
m, 25-watt resistors were used in parallel to obtain
e 50,000 ohms required. (While "Dividohms" were
ed because they were readily available at the time,
ed resistors will serve, of course.) This method
ubles the power rating and provides a measure of
fety in the event one of the resistors burns out.

Of course, the larger the resistance, the smaller the
ire used in a resistor—and the more prone it is to
rn out. Frankly, we prefer the second method—
nployed in the 1500-volt supply—of using two 50,000-
m, 50-watt resistors in series to obtain the 100,000
ms of resistance necessary in this power supply.
his, too, doubles the power rating and provides as
rge wire as feasible.

A multitude of refinements can be made on a power
pply, of course—one of the most worth while being a
fety interlock arrangement in the final installation.
owever, outside of including fuses, switches and pilot
mps in the accompanying circuit diagrams, refine-
ents have been left to the individual builder to include
suits his purpose. In deviating from the power
pplies described herein, however, care should be
ken to insure proper insulation at all points.

Wire with insulation suitable for the voltage involved should be used not only in the power supply unit itself, but also in making inter-unit connections to control panels and transmitters. Adequate mechanical strength should be maintained in the mounting of the heavy transformers and chokes. Input and output connectors can be of any type suitable for the voltages concerned.

The two switches included in the diagrams permit separate control of the rectifier filament power and plate power. The first time the supply is used, a filament warm-up of at least one minute is recommended before applying plate power. This will allow the mercury within the GL-816 tubes to distribute itself properly. This also applies whenever the tubes are removed and replaced. In subsequent operation, it is necessary to allow at least ten seconds for heating the filaments before applying plate power. The power supply should be operated only when the tubes are in a vertical position.

When operated within ratings, these power supplies should give the builder the most satisfactory performance ever experienced with any power supply.

One more thing: DON'T LOAD THE POWER SUPPLY WITH YOUR BODY! Be certain to short-circuit the output terminals before working on anything connected with the supply—even when it is turned to the "OFF" position and even if the a-c line cord is pulled out. Remember that 100 microfarads of capacity holds a lot of "soup" and a burned-out bleeder will allow dangerous voltages to remain in the filter for a matter of *minutes* after it is turned off!

NATIONAL CALLING AND EMERGENCY FREQUENCIES

C.W.		'PHONE	
3550 kc	14,050 kc	3875 kc	14,225 kc
7100 kc	21,050 kc	7250 kc	21,400 kc
28,100 kc		29,640 kc	

During periods of communications emergency these channels will be monitored for emergency traffic. At other times, these frequencies can be used as general calling frequencies to expedite general traffic movement between amateur stations. Emergency traffic has precedence. After contact has been made the frequency should be vacated immediately to accommodate other callers.

The following are the National Calling and Emergency Frequencies for Canada: c.w.—3535, 7050, 14,060; 'phone—3815, 14,160, 28,250 kc.

NATIONAL RTTY CALLING AND WORKING FREQUENCY

3620 kc

PARASITICS

In the "Designer's Corner" of the last issue of G-E HAM NEWS (Volume 9, No. 1) the formula for the resonant frequency should, of course, have read:

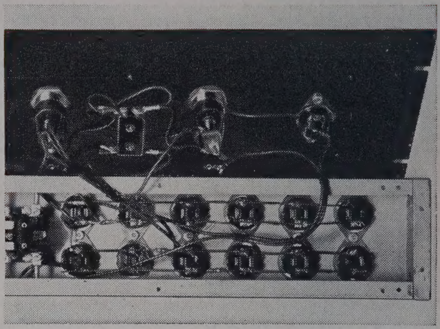
$$f=\frac{1}{2\pi\sqrt{LC}}.$$

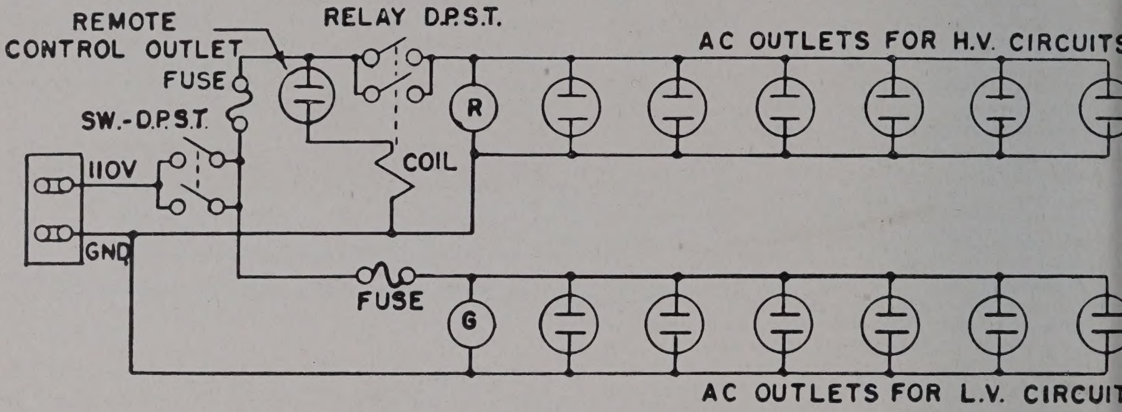
control unit

Somehow the problem of how to switch the rig and associated equipment on and off seems to sneak up on a fellow unsuspectingly. He concentrates on his transmitter, receiver, converters, VFO and the other pieces of equipment and when he gets them all working suddenly realizes he doesn't have any way to operate them without flipping a dozen or so separate switches.

Then he has to scramble around hunting in handbooks and magazines and calling up his friends to get ideas for a control unit of some sort. Of course, it's not a difficult problem, and there are endless ways of solving it.

We present this solution—found in the shack of W2GYV—as one more suggestion to add to the pile. This is a 7-inch control panel with a 4 x 17 x 3-inch chassis mounted as shown.





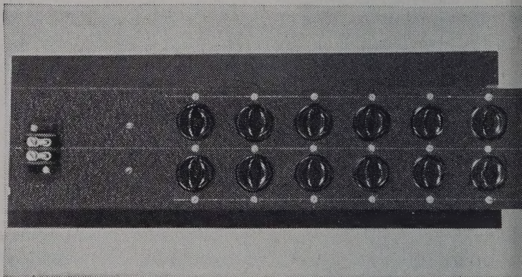
The circuit is simple and provides for remote control via the a-c type female outlet on the front of the panel. On the rear of the unit are two rows of a-c outlets—both supplying 110-volt a-c. The bottom row of six outlets is controlled by the front panel switch and is used for filament circuits in other pieces of equipment. The top row of outlets is controlled by the same switch plus the relay, and offers 110-volt a-c for the high-voltage plate transformers of various pieces of equipment.

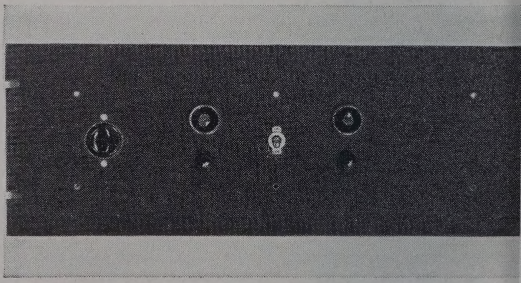
An interesting feature of the circuit is that the relay coil is connected in the grounded side of the 110-volt a-c circuit. This method of connecting the coil eliminates any possibility of the relay being actuated if the hot lead in the remote control cable should accidentally become grounded. Incidentally, the relay used here is a double-pole type to provide a wide margin of current-carrying capacity and to halve the possibility of poor contact because of dirt or corrosion. A single-pole relay can be used.

The toggle switch shown is a heavy-duty, double-pole type to insure plenty of current-carrying capacity. The fuses used should be chosen to just carry the total current that will be drawn in their respective circuits.

The photographs show the construction clearly. Note that the mounting plates for the a-c outlets are overlapped to fit neatly in the chassis. Nothing in the construction is critical and the builder can make whatever variations are necessary to suit his purpose.

One excellent feature to add would be an interlock switch in series with the remote control outlet.





SWEEPING *the* SPECTRUM

Vhile we were working on the power supplies de- ibed in this issue, the editor stopped by and made a comments inspired by our ideas on doubling the eder resistors.

'I'll bet a lot of fellows don't realize how dangerous leeder resistor can be," he said. "It gives a person a se sense of security, and he forgets or at least never ly realizes that a burned-out bleeder can leave his wer supply filter set up like a baited trap—ready to ock the unwary for what might very well be his last p.

'It may sound corny and trite," he went on. "But ite up that safety angle just as strong as you can. I s lucky. I learned the easy way. One time I had rrowed a power supply and in hooking it up had asion to turn it upside-down and work on the output nnection. Of course, I shut off the switch and then— rely out of habit—I shorted the output with a screw- ver. I'd developed this habit because I hadn't been ng a bleeder—not because I was afraid of a burned- t bleeder.

"Well, there was an arc, a big one. I thought nothing it for a moment. Then I saw the supply had a bleeder d it occurred to me that there shouldn't have been y arc. I checked the bleeder. Sure enough, it was en.

"Before that happened I'd considered the possibility an open bleeder purely academic, and I'd merely en lip service to safety. But that arc was plenty real d since then—well, I'm still here.

"While you're about it, Larry, you might write in a uple more things about safety . . . about keeping one nd in your pocket when you adjust live equipment . standing on a dry floor . . . or better, don't adjust e equipment.

"Don't mind if some of the boys say it's old stuff. are a few lines of type on a plea for safety—and aybe save a life."

So, fellows, when working on these power supplies anything connected with them, keep a sort of ental red neon sign flashing in your mind—a sign at reads: "DANGER—HIGH VOLTAGE."

* * *

Beginners often ask: "What should I start out with r a transmitter?" It's a simple question, seemingly, t after I start thinking about it I feel about as con- sed as the fellow who asked the question.

Perhaps the answer is that there is no general answer all. Checking with the fellows around here shows at it all depends on circumstances what you start t with in ham radio. A few of the lads, presumably born in a gold mine, began with rather expensive commercially built rigs. At the other extreme are fellows who dismantled old broadcast receivers and built low-power rigs from the parts. Some of the boys started as Jr. OP's, cut their eyeteeth on the old man's discarded B batteries, and apparently had all the necessary parts available to begin to put things together as soon as they were big enough to lift a soldering iron. Then, of course, there's the bunch who started out with a great big zero in the way of either tools or equipment. And you know, they weren't so bad off in the end because while they were scrimping and saving to buy some tools and parts, they had plenty of time to think things all over, visit other hams and decide what they really wanted—instead of rushing out and buying, in their ignorance, a white elephant.

Most fellows seem to want a bandswitching rig. But this has two disadvantages. A compromise in performance almost always is unavoidable. Also, the chances are high that a good part of the circuitry will never be used to full advantage—thus a fair share of the investment will be wasted.

The advice of two of the lads I talked this problem over with is for the beginner to start out on just one band with a small transmitter—preferably a CW rig. They point out that this opens the way to a lot of fun and experience for not too much money. Of course, it is agreed that eventually the beginner who does this will want to try other bands and various types of modulation.

A lot of fellows end up with several small rigs—each for a separate band or mode of operation. And if they are not interested in more than 100 watts, they are very happy. Other fellows sell or swap their first small rigs and go into higher power for keeps.

Everyone I've talked to about this problem has agreed on one thing, however: It takes just as much or more time to decide what you want to do, as it does to do it. So you fellows who are worrying because you spend so much time wondering what to build can stop worrying. Your condition is normal. Take your time and plan carefully. It'll save you money in the end.

* * *

First edition of the WVARA NEWS, published by the Wabash Valley Amateur Radio Association of Terre Haute (W9QPD, secretary) has appeared. It contains news notes of members, a YL section, a feature spotlighting one of their novices (WN9AWW), and a Trading Post section. Congratulations, fellows, on the new bulletin.

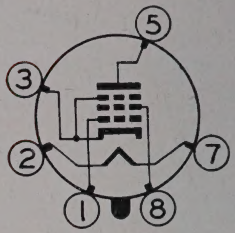
—*Lighthouse Larry*

Technical Information 6AV

BEAM POWER PENTODE

Amateurs looking for a power tube with high-current–low-voltage characteristics for use in low-power RF-applications may find the 6AV5 of special interest. While designed for use as a horizontal deflection amplifier in TV receivers, it should outperform the 6L6 when properly used as a buffer, multiplier or final amplifier. The tube served excellently as a clamp modulator in the 6-meter rig described in G-E HAM NEWS, Volume 7, No. 1. It is an octal base GT tube with a 6.3-volt a-c or d-c filament drawing 1.2 amperes.

BASING DIAGRAM



Bottom View

RATINGS AND CHARACTERISTICS

	Maximum	Average
Plate voltage	550 volts	250 volts
Screen voltage	200 volts	150 volts
Control grid voltage	—100 volts	—22.5 volts
Plate dissipation	11 watts	—
Screen dissipation	2.5 watts	—
Plate current	100 milliamperes	55 milliampe
Screen current	—	2.1 milliampe
Transconductance	—	5800 micromho

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S. E. McCALLUM, W2ZBY—*EDITOR*

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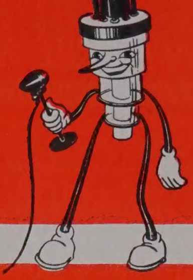

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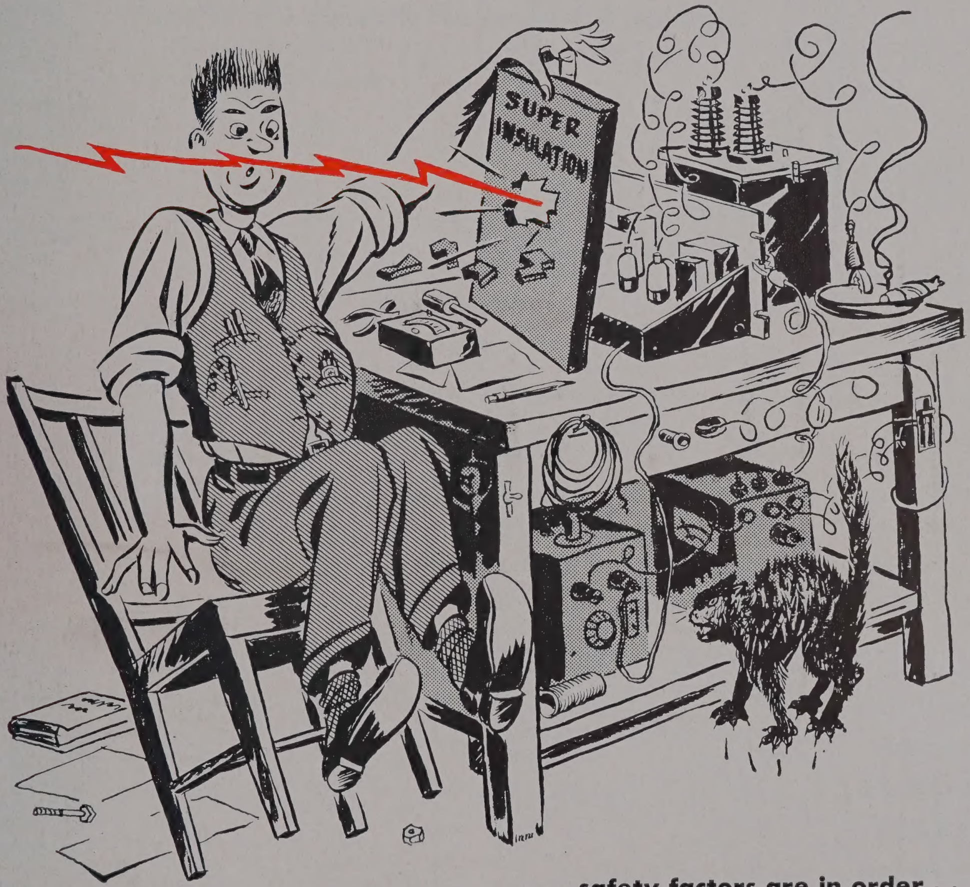
MAY–JUNE, 1954

VOL. 9—NO. 3

PICKING THE PROPER INSULATION



. . . safety factors are in order . . .

ontents

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1953 Edison Radio Amateur Award Winner .... Page 4
Sweeping the Spectrum .... Page 7
A Streamlined Rectifier .... Page 8

PICKING THE PROPER INSULATION

It is generally recognized the primary function of electrical insulation is to guide current flow through desired paths and to separate electrical circuits and conductors which operate at different voltages. Furthermore, it is evident there are gross differences in the way insulations perform. For example, coils wound on polystyrene forms have a higher "Q" than those wound on molded mud forms; and certain circuits require the use of mica capacitors while in others cheaper paper capacitors will perform satisfactorily.

What are the electrical specifications by which the performance of insulation is measured? What considerations are involved in the selection of the proper insulation for a particular job?

Some specifications (like power factor) are easily measured and known to a few percent. Others (li puncture strength) are very nebulous and must be us with a great deal of caution in any design applicatio

Liquid and solid materials are broadly divided i classes according to their ability to conduct electricit To be specific, when we measure the resistance of number of liquid and solid materials between two me plates each 1 inch square and separated by 1 inch (s Figure 1), we find most metals and acids are relative good conductors of electricity while mineral oil, gla wood, rubber and plastics are relatively poor condu tors. The resistance of a sample having the afo mentioned dimensions is called ***resistivity*** and is mea ured by a special unit called ohm-inches.

Between the two extremes (*i.e.*, the conductors a

TABLE I

Insulation Specifications* (Measured at 25°C)

Material	Resistivity (ohm-in. at 30% rel. humidity or lower)	Dielectric Constant	Power Factor (%)			Puncture Strength	
			60 cy	1 mc	100 mc	d-c or peak a-c V/mil	Thicknes of test sample
INORGANIC							
air	infinite	1	0	0	0	20	
mica	10^{13}	5–7	0.5	0.04	0.02	600–900	.004″
Mycalex	10^{15}	7	0.64	0.21	0.22	360	.2″
steatite	10^{14}	6	0.2	0.3	0.2	240	.250″
glass (Pyrex)	10^{14}	5	0.8	0.3	0.4	335	
barium titanate	10^{13}	1200	6.0	1.0	1.0	75 (approx)	
ORGANIC							
Teflon	10^{16}	2.1	0.02	0.02	0.02	250–1600	.012″
polyethylene	10^{16}	2.2	0.01	0.02	0.04	400	.125″
polystyrene	10^{18}	2.6	0.02	0.02	0.05	600	.125″
black Bakelite	10^{14}	5	1.0	0.5	0.5	350	.125″
Lucite Plexiglass	10^{16}	3	6.0	2.0	1.0	500	.125″
Kel-F fluorothene	10^{18}	2.5	2.0	0.9	0.5	400–2500	.125″
hard rubber	10^{15}	3	0.4	6.0	—	400	.125″
paper	—	4	1.0	4.0	6.0	200	.125″

**A large number of the values quoted here taken from the Massachusetts Institute of Technology "Tables of Dielectric Materials."*

ators) lies an intermediate group of materials d semiconductors. We have heard a great deal y about their use as transistors; however, they uct electricity too well to be useful as insulation. arbitrary boundaries in resistivity of semiconduc- are generally taken to be 1 ohm-inch and 10^6 ohm- es.

Table I are listed a number of materials used as ation, together with their most important elec- l specifications—namely, resistivity, dielectric tant, power factor and puncture strength.

the first column it will be noted that the resistivity es for these insulators are all a million times or e larger than the upper limit of the semiconduc- . The measurement of such large resistances is not , but by using thin samples and 500 volts or more lied to large electrodes, values up to about 10^{16} -inches can be measured accurately. The values ted in Table I were measured at a relative humidity 0% or lower. Moisture absorbed within or on the aces of high resistivity insulation can seriously er the values measured.

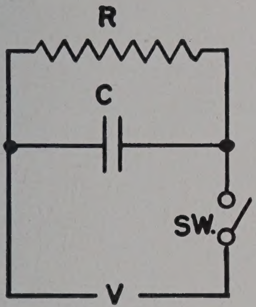
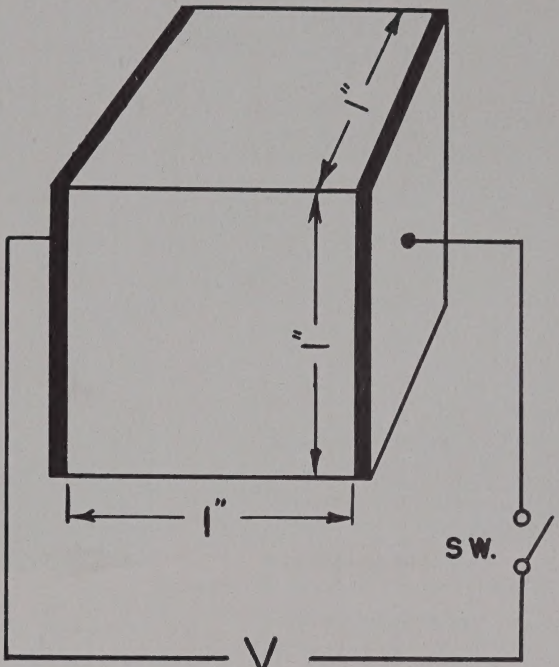


Figure 1



onsider next the currents that flow through the k of insulation shown in Figure 1 when voltage V uddenly applied by closing the switch. If V is a d-c age, there is a rush of charging current which dually decays to some steady value determined by resistivity of the material and the applied voltage. wever, when a-c voltage is applied, although most he current leads the voltage by 90° ($I_{capacitive}$), a ll but measurable current component is in phase h the voltage (I_{ohmic}). The vector diagram of Figure presents these two currents.

ow the ohmic current alone produces heat. The ount of heat is determined by the d-c resistivity of insulation in conjunction with some extra heat erated when the molecules of the insulation rub inst each other as they move under the influence of a-c voltage.

hus the cube of insulation could be represented cir- -wise by a resistance shunted across a "perfect" acitor—that is, a capacitor in which all the current out of phase with the applied voltage. For "good" lation of the type we are considering, the ratio of heat-producing current (I_{ohmic}) to the no-heat-producing current ($I_{capacitive}$) is called the power factor of the insulation.

In other words, the power factor is the number by which the "apparent" power* of a capacitor-resistor combination must be multiplied to obtain the actual watts of heat developed. The power factor is a number (usually expressed as a percentage) which can vary from 0% for a perfect insulator such as air to 100% for a perfect conductor.

For most commonly used insulators the power factor is less than 5%, and it may be as low as .02% for the very best insulators such as polystyrene or mica.

Now as indicated previously, the a-c resistivity of an insulator is in part determined by the movement of the molecules under the influence of the a-c voltage. The net result is to cause the power factor to change in a rather complicated manner with variations in the frequency of the measuring voltage. This is reflected in the power-factor columns in Table I which show it is meaningless to quote a power factor without specifying the frequency at which the measurement was made.

This variation with frequency illustrates why it is of utmost importance in many applications to choose a coil form of suitable material when working with RF circuits. For instance, a paper coil form would have a power factor of 1% at 60 cycles but 6% at 100 megacycles. And in comparing two different types of coil form material it is seen that the power factor of black Bakelite is .5% at 100 megacycles while polystyrene is .05% at the same frequency. Thus the efficiency and Q of an RF circuit can very well be quite dependent upon the type of insulation used.

---

* The "apparent power" or "volt-amperes" drawn by a circuit containing both resistance and reactance (as in Fig. 1) is obtained by multiplying the voltage across the circuit by the total current drawn without regard to their relative phases. Actually, power is consumed in the resistor only; the "power" in the capacitor being simply transferred back and forth between the source and the capacitor. Therefore, we define the power factor as the ratio of the actual power consumed by the resistor (which appears as heat) to the apparent power drawn by both resistor and capacitor.

(Continued on page 6)

EDISON RAD

1953 Edison Radio Amateur Award

J. Stan Surber

W9NZZ

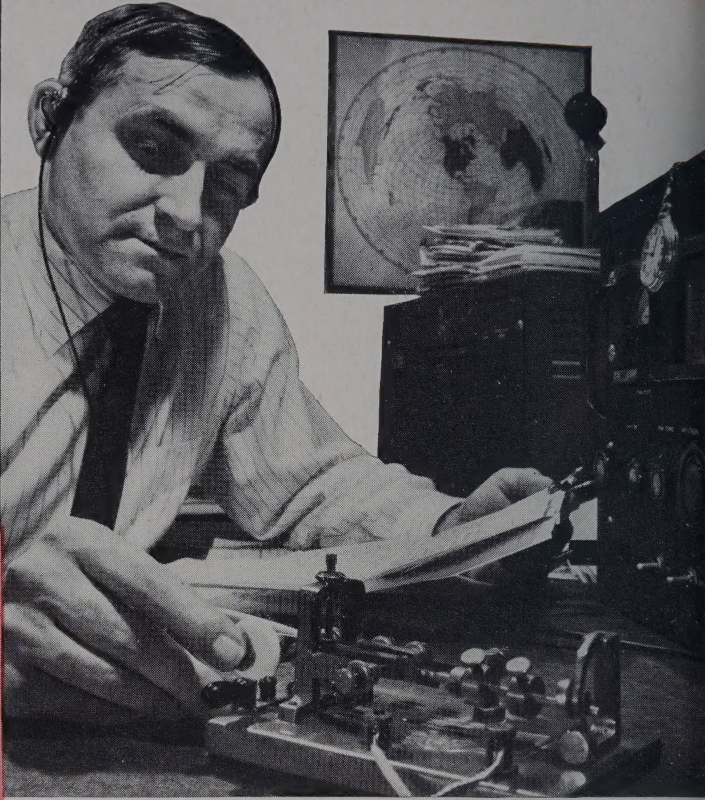
THESE IMPARTIAL JUDGES picked W9NZZ as the radio amateur who performed the most outstanding public service during 1953:

E. ROLAND HARRIMAN
President, The American Red Cross

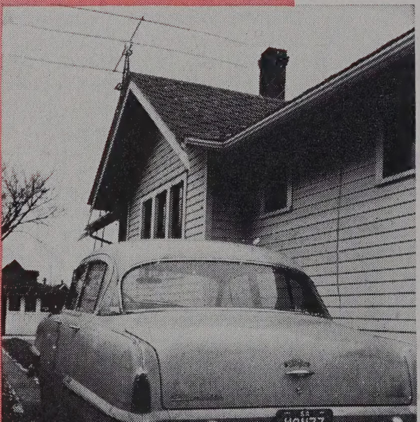
GEORGE E. STERLING
Commissioner, Federal Communications Commission

GOODWIN L. DOSLAND
President, American Radio Relay League

GARDNER COWLES
President and Editor, "Look" Magazine



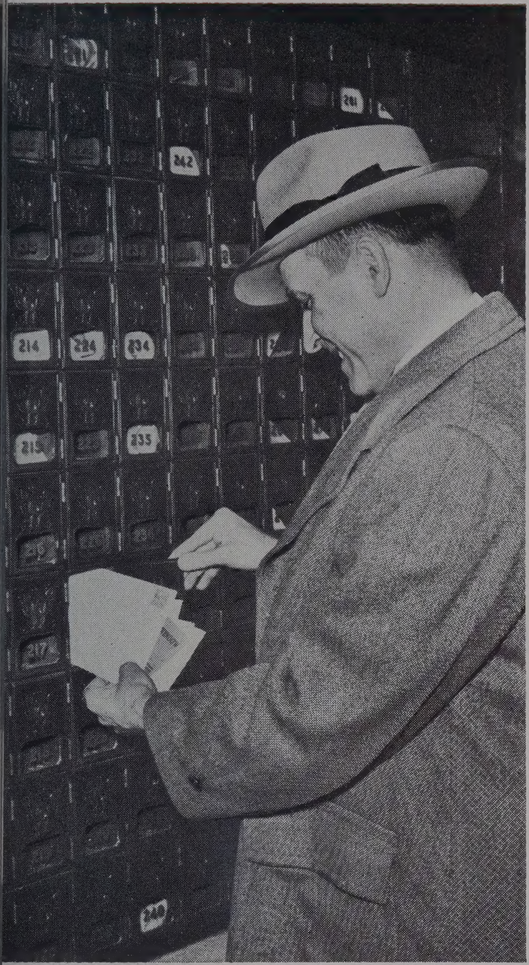
The "helping hand" operating this ivory-handled bug (ha
carved from walrus tusk) belongs to W9NZZ, winner of Gene
Electric's 1953 Edison Radio Amateur Award. Though he ne
tops the monthly BPL list, he'll count words with anyone.



His 20-meter beam stays pointed north to squirt CW to remote weather stations near the Pole where crews are lucky to get mail more than twice a year. (Note Indiana call-letter license plate.)

News of winning the Award came via 75-f
from K4AF (MARS) via W9CMT (left)
W9NZZ was on his 4 pm-to-midnight trick
C&O RR dispatcher.

MATEUR AWARD WINNER



Stan starts each day with early trip to post office to ck up mail for arctic weather men. In 1953 he kept gular skeds with arctic stations 353 days.

XYL Louise serves lunch at the rig so he can keep two skeds with each station most days. She won a wrist watch from G.E. as a "Most Understanding Wife." Louise works the same hours as the OM as PBX operator for C&O.

Stan loves to explain his hobby to neighbors (left) and gets many souvenirs from devoted friends he has never seen (above). Traffic piled up when Award ceremonies broke up skeds—but he reports operations now on a current basis again.

PICKING THE PROPER INSULATION

(*Cont'd from page 3*)

It is a familiar fact that the capacity of a condenser depends on the area and separation of the plates, but perhaps not nearly so well appreciated is the fact that capacity also depends on the *kind* of material between the plates. This has led to the use of the dimensionless quantity called the dielectric constant which usually is denoted by the letter K.

Suppose we measure the capacity of the condenser of Figure 1 first with a solid insulation between the plates and then with just air between the plates. The capacitance obtained with the solid insulation divided by the capacitance obtained with air insulation gives us the dielectric constant. In this way, the K of air is always 1. The K of the so-called "high-K" materials like barium titanate may have a value of more than 1000 (see Table I).

The principal effect of this number is to determine the capacitance per cubic inch that may be obtained in a capacitor. Thus a capacitor made with mica insulation could be made more compact than a paper-insulated capacitor of the same value since the dielectric constant of paper is 2 and mica is 7. For the same reason, a Pyranol filled capacitor is much smaller than an oil-filled capacitor of the same value.

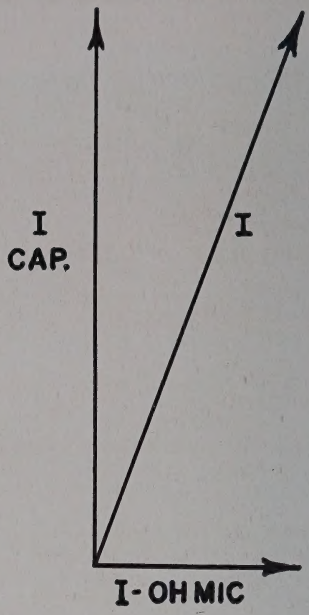
The last of the more important electrical ratings assigned to insulation is the "puncture" or dielectric strength. This usually is expressed in volts per mil, and gives the measure of the amount of voltage necessary to puncture a piece of insulation. While the puncture strengths in Table I are quoted in volts per mil of insulation thickness, these values are not scalable over a wide range of thickness. The puncture strengths in Table I apply to measurements made with flat electrodes with carefully polished and rounded edges on insulation about 1/8 inch thick. This condition rarely is attained in practice with the result the strengths listed in Table I are all apt to be higher than would be encountered in practical situations. Thus safety factors of the order of 100% must be applied to any design based on these numbers.

Although such a listing of puncture strengths is qualitative at best, the following generalizations may be made: (a) Gases (like air) at ordinary pressures have puncture strengths about ten times lower than most solids; and (b) solid insulators 1/8 to 1/4 inch thick have strengths of several hundred volts/mil except in the case of mica and very thin plastic sheets (a few mils) which may have a puncture strength as large as 1000 volts/mil.

A fact worth noting is that breakdown usually culminates in a high-temperature arc. While this is of little consequence with air and ceramic insulation, organic insulation will be charred by the arc and the carbon track created will then break down at a much lower voltage than that which caused the initial failure. This fact may be of importance when selecting an insulation for high voltage applications where arcing is expected. Often breakdowns occur in transformers where voltage taps are brought out from the windings. If the charred varnished cambric insulation is carefully cut away with a knife or razor blade, and the resulting void filled with plastic cement such as Glyptal, the transformer may sometimes be saved.

Breakdown between two conductors in certain situations may be eliminated by inserting a sheet of solid insulation between them. A piece of mica or thin sheet of plastic often will do the trick.

Sharp points on conductors cause breakdown at lower voltages than will occur with smooth-surfaced conductors under otherwise equal conditions. Thus, care should be taken to polish capacitor plate edges, kee the plates dust-free and to round-off conductors in high voltage circuits. For example, globlets of solder wi sufficiently smooth the ends of two pieces of No. 1 wire that have been cut with side cutters so that th breakdown voltage rating of the gap will be doubled



$$P.F. = \frac{I\ OHMIC}{I\ CAPACITIVE}$$

Figure 2

A discussion of insulation would not be complet without mention of the effect of moisture. Moistur will lower the breakdown voltage of many kinds of insulation, especially the paper and cloth varieties. Thus it is wise to allow ample "dry-out" time of high-voltag gear that has been stored in damp locations.

Furthermore, moisture absorbed on the surfaces o plastics will cause their power factors (and attenuatio per foot) to rise. Almost every ham who has operate in wet weather with twin conductors insulated wit polyethylene has noticed this effect. By actual measurement at 100 megacycles, the attenuation per hundre feet of one variety of twin lead conductors increase from 1.2 decibels to 6.5 decibels when its surface wa wet. The application of water-repellent materials lik silicones to these surfaces often will improve performance of insulation under adverse moisture conditions

All the values quoted in Table I apply to measurements made at room temperature. Generally speaking at higher temperatures the performance of insulatin materials becomes poorer. As the operating temperature of a given insulation is raised, the resistivity dielectric constant, and puncture voltage becomes lowe while the power factor rises—W2UKL.

SWEEPING *the* SPECTRUM

Judging from the requests we've had for back copies G-E HAM NEWS concerned with SSB, the rush to is type of emission definitely is on.

SSB fone work is so fast that there are an awful lot long silences in these QSOs. Even the most long-nded fone men find they can run out of steam pretty st on SSB.

One result of this situation has been the building up super round tables—round tables of a size that would completely impractical in push-to-talk operation. ıt in SSB's talk-to-talk operation anyone can stick his two cents just by speaking up.

Did we say "anyone"? We'll correct that. All the gher-power boys in the round tables merely speak up. ıt the unfortunate low-power boys (5 watts peak or) have a kind of rough time in these super round bles because everyone has his receiver turned down the roof won't blow off when the 4-250As speak up. even though the 6AG7 boys can work all districts thout straining their filaments, they get lost in the und tables. Thus the rush is on not only to SSB, but high-power SSB!

One thing is lacking in the SSB world as we write—nest-to-goodness traffic nets. SSB offers perhaps ore to the traffic men than to other operators. So far, B has been the pride and joy of, first, the more chnical-minded hams and now the rag-chewers. But equipment and circuits become more standardized d we find ways to lick the stability problem, we feel B has a future in traffic work.

Don't think for a moment we mean that the tech-cians and rag-chewers are going to turn into traffic-en en masse. Not at all. The biggest single factor in affic nets are the operators—the guys and gals with a rticular kind of intense persistence and whose main jective in life is to "get that message through." hey're born, not made. And we feel sure that when ey latch onto SSB communications, there'll be no opping them. Of course, a complete change-over on entire traffic net is a problem not wholly technical—problem of economics. (How many lads can afford to rap an AM rig they've given, in effect, their life's ood to acquire?) The transition will be slow. But we el that now is the time to start planning and operating B TFC.

Don't think that with all this talk of fone work we're ighting good, reliable CW. We ask around among our iends every once in a while about whether they prefer ne or CW—and it's about half and half as far as we n figure. Lots of fellows like to work both. Our editor imself said he's probably the worst CW man in the orld—but just the same he likes it best.

So we're keeping eyes open for good CW rigs, too. ne of the best 80/40-meter CW rigs we know of is the Economy Half-Kilowatt" described in G-E HAM EWS, Volume 3, No. 5. It's a two-control, two-stage FO job that's a delight to operate. It uses a 1614 (but a 6L6 works fine) and a GL-4D21/4-125A. Be glad to send you one of these back copies.

⁂ ⁂ ⁂

In Cardiff, Wales, a case of TVI was traced to the 42-inch pendulum of a spring grandfather clock, and was remedied by grounding the metal works, according to "Sparks," the Brandon, Manitoba, club bulletin . . . the Ak-Sar-Ben Club of Omaha, reports "Ham Hum," has started an annual award (a first-class communications receiver) for the member who will be adjudged as having done the most for amateur radio during 1954 . . . the same bulletin reports 25 SSB stations in the Northeast Nebraska area where only 2 operated a year ago . . . Old-timers' hearing tapers off at 10,200 cps or so while the younger lads easily catch 15,000 cps, according to W9UIA in a talk on loudspeaker problems at a meeting of Tri-State ARA at Evansville, Ind. WN9YZO, a medico, says this is due to hardening of the inner ear with age . . .

⁂ ⁂ ⁂

Hams long have been known for the fine job they do in policing their own ranks. Recent comments from OO's, for example, indicate that their friendly warnings to brother hams are received in good grace and with fervent thanks in nearly every case.

Now we note comments in two widely separated local ham club bulletins which indicate some organized self-policing may be in order in a new field—among those fortunate enough to be granted auto license plates bearing their call letters.

The license plate program has met with considerable success throughout the nation—and has given us a great boost in publicity. In many cases we are thus put on a level with doctors and other public servants.

However, as we attain this stature we also have to remember that it behooves us to live up to our new standing—by added care and courtesy on the road. Need more be said than to comment that every traffic ticket a ham with call-letter license plates gets is a black eye for ham radio? And suppose through our carelessness it should be something worse than just a "ticket"? Suppose it's a broken, twisted body of a child on the highway? We see such pictures in the newspaper once in a while. And I fervently hope I never see one which includes a "murder car" bearing ham call-letter license plates.

You think this is a painful and unpleasant subject? Sure is. But not half as painful and unpleasant as the real thing. We bring it up in the hopes that a few thoughts now, beforehand, may prevent the real thing from ever happening.

—*Lighthouse Larry*

A STREAMLINED RECTIFIER

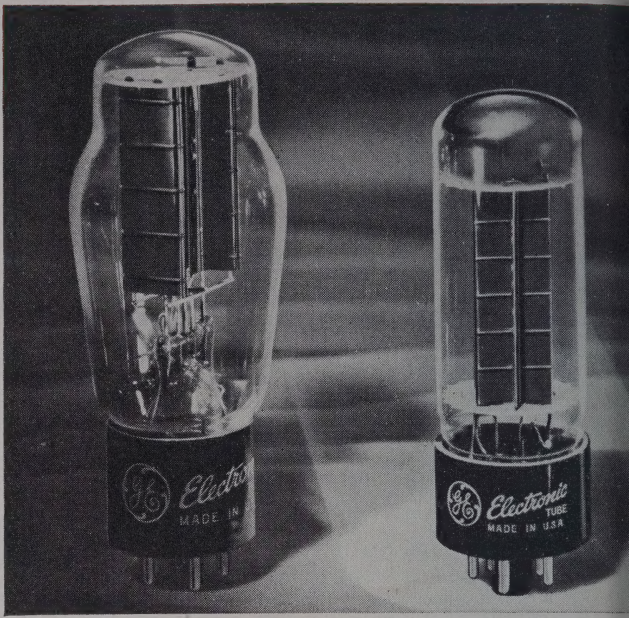
The new "Service-Designed" GL-5U4-GA has slightly higher output voltage and current ratings than the old 5U4-G and a streamlined envelope and sturdier construction—all of which make it more adaptable to ham use.

Here's the difference:

	OLD 5U4-G	NEW 5U4-GA
MAXIMUM RATINGS		
Steady state peak current per plate	675 ma	900 ma
Transient peak current per plate (Maximum duration 0.2 second)	4.0 amp	4.3 amp
TYPICAL OPERATION		
With capacitor-input filter:		
AC Plate supply voltage per plate, RMS	450 volts	450 volts
Filter input capacitor	10 mfd	40 mfd
DC output current	225 ma	250 ma
With choke-input filter:		
AC Plate supply voltage per plate, RMS	550 volts	550 volts
Filter input choke	3 hy	10 hy
DC output current	225 ma	250 ma
Tube voltage drop (at 225 ma load)	50 volts	44 volts

The envelope is shorter and narrower than the old model, and thus saves space. Note the mica support at bottom as well as top—which together with the new "button stem" construction makes a sturdier tube.

Shock and vibration tests show the new 5U4-GA can withstand the hard usage of Field Day and portable operation.



OLD 5U4-G **GL-5U4-GA**

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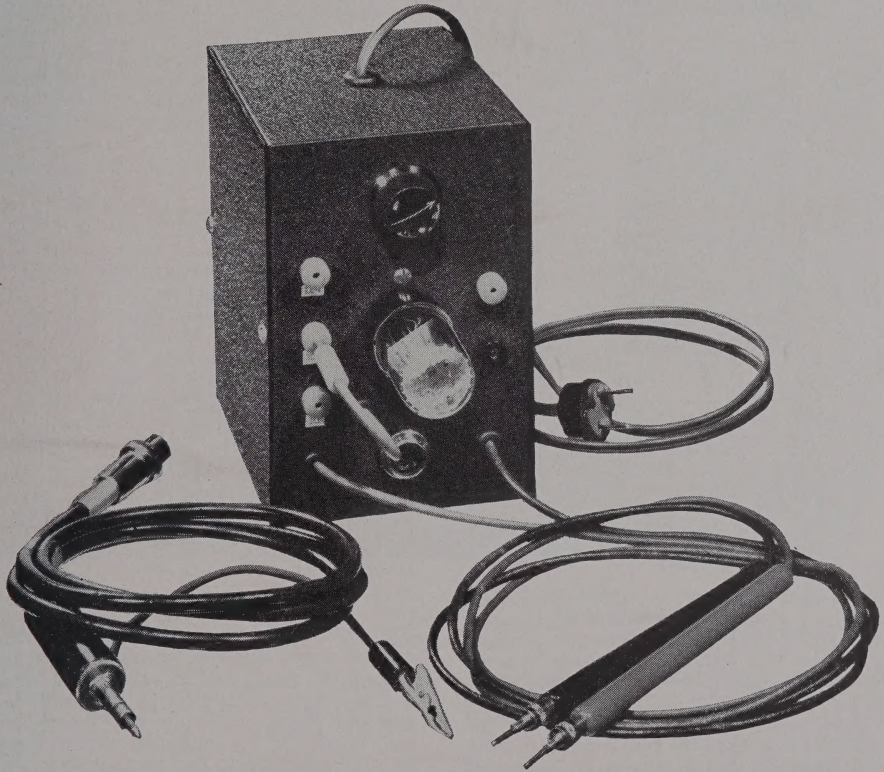
VOL. 9–NO. 4

VTVM Adapter

• • • makes a Vacuum Tube Voltmeter out of any standard Multi-meter



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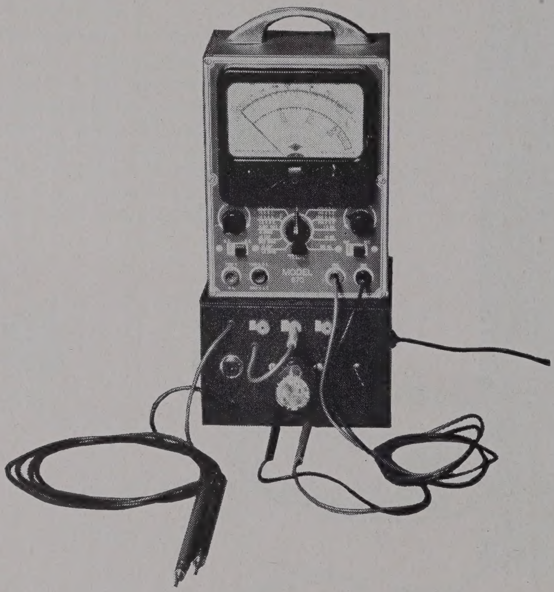
VTVM Adapter

A vacuum tube voltmeter is one of those instruments a ham doesn't like to pay for but sure wants badly on certain occasions. As a result, a good many hams settle for a relatively inexpensive multi-meter for all-around work and then hope for the best when it comes to measuring critical circuits.

But here's an adapter that will make a VTVM out of any multi-meter. The cost should not be high as most hams probably can find many of the necessary parts around the shack. The model shown is built in a utility box—but could just as well have been put on a bread board or an old chassis.

When used with a multi-meter, this adapter measures DC potential fairly accurately in three ranges: 0 to 4 volts, 0 to 40 volts, and 0 to 400 volts. It also measures RF voltages in the first two ranges; and gives indications of RF up to 250 megacycles.



CIRCUIT DETAILS

The VTVM adapter employs a 6SN7-GTA twin triode in the manner shown in the circuit diagram. A multi-meter set on its 50-volt DC range is plugged into J_5 and J_6. Then with adapter test leads shorted the wire-wound potentiometer R_8 is adjusted to eliminate any difference of potential between the plates of the triodes. This condition is indicated when the multi-meter needle reads zero. At this condition, each plate of the 6SN7-GTA in the model illustrated is precisely 120 volts above ground.

When the adapter test leads are applied to a voltage point and ground, the bias on one half the 6SN7-GTA is upset and this half starts drawing current. This causes a difference of potential between the plates of the twin triode, and of course the multi-meter reads this difference. The high range of this adapter reads 0 to 400 volts; the middle range 0 to 40 volts, and the low range 0 to 4 volts—all reading on the 0-50 scale of the multi-meter.

In the circuit shown, little difference was appar when using multi-meters varying in resistance fr 1000 ohms per volt to 20,000 ohms per volt. Th although the multi-meters drew some current fr the plate circuit of the VTVM tube, it was not enou to seriously affect the meter reading. And of cour with the high input resistance of the VTVM, v little current is drawn from the circuit under test. is quite conceivable that slight variations in t Adapter circuit would cause a wider variance in t operation of multi-meters of different resistance.

Three different multi-meters were tried with t VTVM Adapter and all gave the truest readings wh set on their 50-volt ranges. In one case, the near thing to a 50-volt range was a 75-volt range. In che ing against a laboratory standard power supply, was found that this particular multi-meter used alo read a little high. This same error was reflected in t readings when the VTVM Adapter was used and t multi-meter set on its 75-volt range.

This multi-meter also has a 150-volt range, a 15-v range and a 7.5-volt range. However, when set on t 15- and 7.5-volt ranges and connected to the VTV Adapter the errors at low voltages rendered readi almost useless due to the low value of resistance shunt across the 6SN7-GTA plates. This multi-meter has resistance of 1000 ohms per volt. With the multi-me set on its 150-volt range, readings were usable, b more in error than when the 75-volt range was us because of the difficulty in reading the low end of t scale.

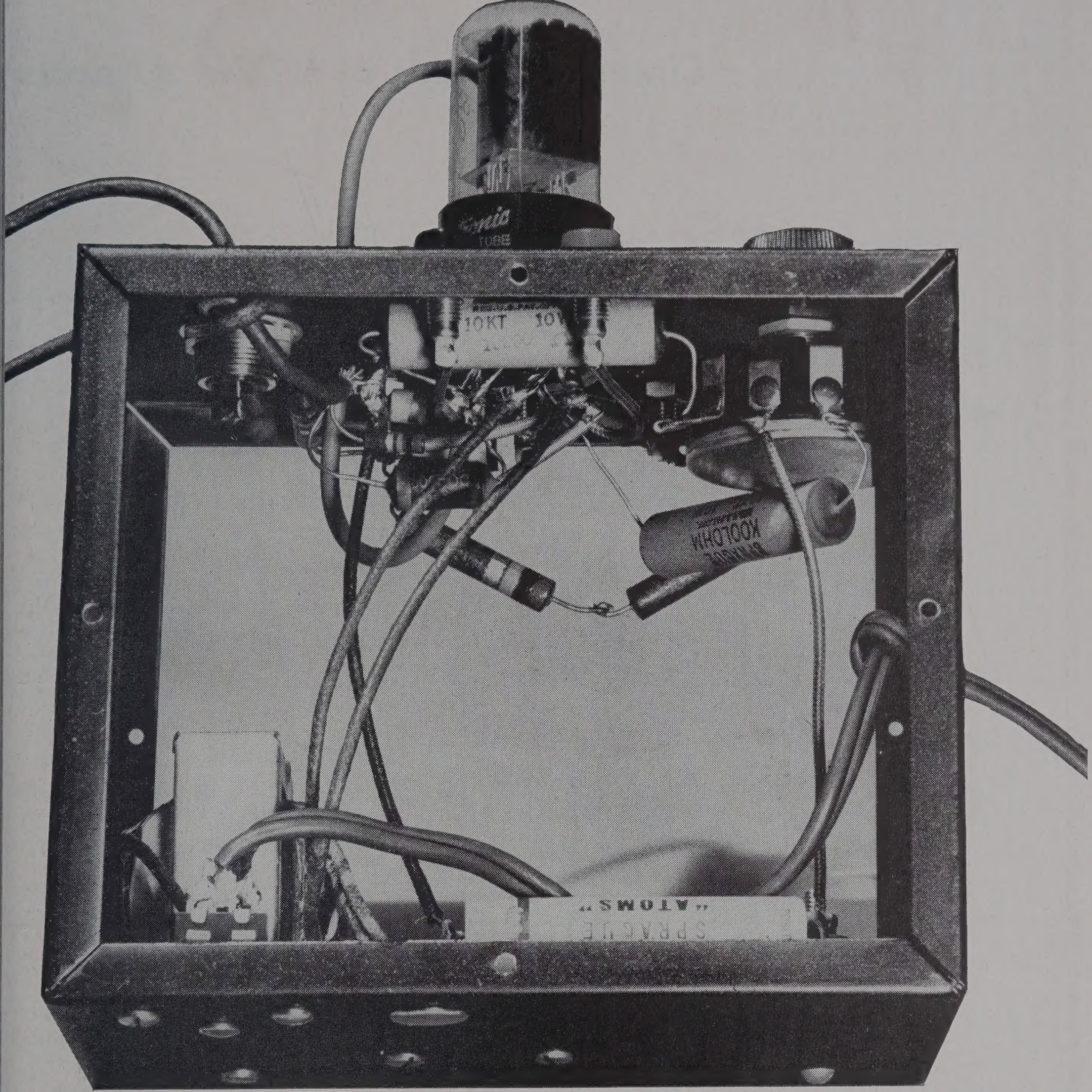
When balanced, 120 volts is on each plate of t 6SN7-GTA in the model illustrated. Tests showed th when 1 volt is applied to the Adapter input (with t Adapter range cord plugged into the 0 to 4-volt ran tip-jack), the potential on one plate of the 6SN7-GT drops to 110 volts while the other plate remains su stantially at 120. This indicates a 10-volt gain in t Adapter. When 300 volts is applied to the Adap input (with the Adapter tip-plug in the 0 to 400-v tip-jack), the one plate of the 6SN7-GTA drops 90 volts while the other plate remains at substantia 120 volts. This, also, indicates a 10-volt gain in t Adapter.

In this manner, voltages up to 4, 40, and 400 w measured fairly accurately, but above this point t 6SN7-GTA became saturated and further increa in voltage made little difference on the scale of t multi-meter. (This actually is a safety feature. F because of this limiting action, overloads of ma times the full-scale value will not harm the met This of course does not mean ordinary care shou not be used, as other parts may be damaged ev though the meter movement itself is not harmed.)

Thus it was found that the useable difference potential between the plates of the 6SN7-GTA rang between 0 and 40 volts. The simplest calibration p cedure is to check the performance of an Adapt multi-meter combination against a good standa VTVM and select the multi-meter range which giv the truest readings. Then stick to using that particu range. As mentioned above, this was found to be t 50-volt range or thereabouts in the multi-meters teste

RF PROBE OPERATION

The RF probe measures voltages fairly accurat in alternating-current circuits operating at radio f quencies up to 10 megacycles. In a test with a standa



nal generator, an RF voltage of 4 volts read 3.8 lts with the Adapter-multi-meter combination. ove 10 megacycles the sensitivity fell off and the apter no longer gave an accurate reading. However, presence of RF on the coil of a grid dip oscillator s still indicated by the Adapter up to 250 megacycles. Thus outside of its useful range in measuring volte, the RF probe serves well in the role of signal cer.

Of course, care must be taken not to exceed the ltage rating of the germanium diode. The type 48 used in this probe is rated at 85 volts peak verse and 400 milliamperes maximum surge current one second. Average shunt capacity is 0.8 microcrofarad. Although other types of crystal diodes n be used, it is best to choose one with as high a peak verse voltage rating as possible.

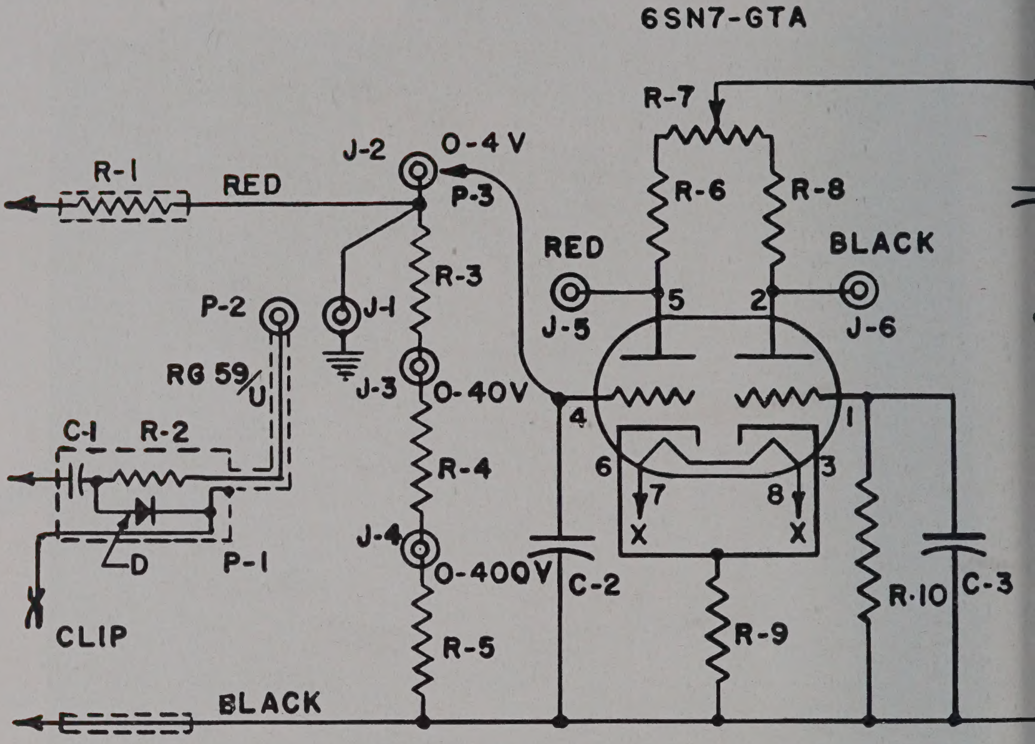
CONSTRUCTION DETAILS

A 4x5x6-inch utility box provides more than enough room for the essential "works"—and, in addition, leaves space for incorporating a meter into the unit if desired. The tube was mounted outside the box to eliminate the necessity for a special tube socket bracket, to keep the heat outside the box, and to act as a pilot light. A builder anticipating rough usage could, of course, place the tube inside.

Red and black tip-jacks are used for the positive and negative multi-meter leads. The 0 to 4, 0 to 40 and 0 to 400 range tip-jacks are labeled accordingly. The flexible cord with the tip-plug which changes the range could be replaced by a switch.

The chassis connector for the RF probe is merely connected in parallel with the low-range input tip-

Circuit diagram of VTVM Adapter

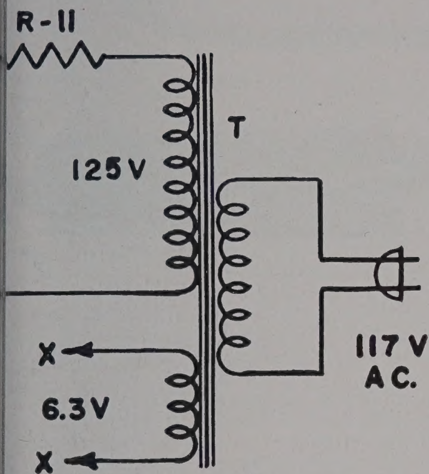

6SN7-GTA
R-7
R-1
RED
J-2
0-4 V
P-3
R-6
R-8
RED
BLACK
R-3
P-2
J-1
5
2
J-5
J-6
RG 59/U
J-3
0-40V
4
1
C-1
R-2
R-4
6
3
7
8
X
X
J-4
0-400V
C-2
D
P-1
R-10
C-3
CLIP
R-9
R-5
BLACK

(Resistors ½-watt unless otherwise indicated)

R_1—1 megohm
R_2—3.3 megohms
R_3—9.1 megohms
R_4—.91 megohm
R_5—.1 megohm
R_6, R_8—10,000-ohm, 10 watt
R_7—5000-ohm wire-wound potentiometer
R_9—600-ohm, 1-watt
R_{10}—10 megohms
R_{11}—100-ohm, 5-watt
C_1—500 mmf. disc ceramic

C_2, C_3—.01 to
C_4—10 to 20 m
D—Type 1N48
SR—selenium
T—Pri: 117 v.
(Stancor PS
P_1—Phone plu
P_2—Single con
P_3—pin plug
J_1—Single-con
$J_{2\text{-}6}$—tip jack

probe.



e text)

5 v. @ 15 ma. and 6.3 v. @ .6 A
nt)

able connector

hassis receptacle

jack—this separate connector being provided to accommodate the coaxial cable and to permit the RF probe to be detached when not in use. If the DC test leads are wired into the circuit, as in the model illustrated, care should be taken not to allow the positive lead to touch a high-voltage spot when the RF probe is in use.

The RF probe is easily constructed with a 4-foot length of RG-59/U and a phone plug. A plug with solder lugs instead of the machine screw type designed for phone tips was chosen because it provides more room for the resistor, diode and capacitor as well as convenient solder tie points for these components. The construction is clearly shown in the illustration. In this model, the plug tip was removed and the center conductor shaft drilled and tapped to receive a machine screw. The screw then was "beheaded" and filed to a point. With some types of plugs it may be possible to merely reshape the tip to serve as the test lead point. The ground clip lead is soldered on the base of the plug as shown in the illustrations.

Practically any selenium rectifier designed to operate in a 120-volt half-wave rectifier circuit can be used as current drain is very small. A separate power supply can be used, of course, by those who may have a utility supply at hand and wish to avoid the expense of building one to incorporate in this instrument. However, if an external supply is used, care must be taken to make sure the supply voltage is precisely the same every time the meter is used. For variations in the supply voltage may upset the calibration.

USING THE VTVM

A sample of voltage tests made on a grid dip oscillator illustrate the usefulness of a VTVM. The GDO was adjusted so its meter read 1 milliampere. Then the plate voltage was read with first the multi-meter alone, then with an Adapter-multi-meter combination, and finally with a fairly expensive commercially-built VTVM which had been checked against laboratory standards. In each case the effect of the measurement on the GDO current meter was observed.

The multi-meter alone read 46 volts and the GDO current dropped during the test from 1.0 milliampere to .5 milliampere. The Adapter reading was 56 volts and the GDO meter needle dropped only a hair's breadth during the test. The commercially-built VTVM read 55 volts, and again caused only the tiniest flicker on the GDO meter.

The average commercially-built VTVM is granted an error of ±5%—which means in the instance cited above that the 55 volts read with the standard VTVM actually could have been anywhere between 52.2 and 57.8 volts (had the meter not been first checked against a laboratory standard). The Adapter reading came within this range; but the multi-meter reading dropped far below this minimum tolerance. In fact, the 46-volt reading obtained with the multi-meter alone is an error of more than 16%.

The operating manual for the GDO under test* specifies a plate voltage of 40 to 60 volts. So in this case the use of a multi-meter would not have led an experimenter too far astray. However, it is quite conceivable that a minimum of 50 volts might have been specified. Had this been the case, the multi-meter alone would have indicated insufficient voltage, whereas in fact the voltage was well over the 50-volt limit.

The uses to which a VTVM can be put are well illustrated in the ARRL "Course in Radio Fundamentals" and in many standard electronics texts. In addition, the instruction manuals on instruments such as grid dip oscillators often describe how the usefulness of such instruments can be extended when used in conjunction with a VTVM.

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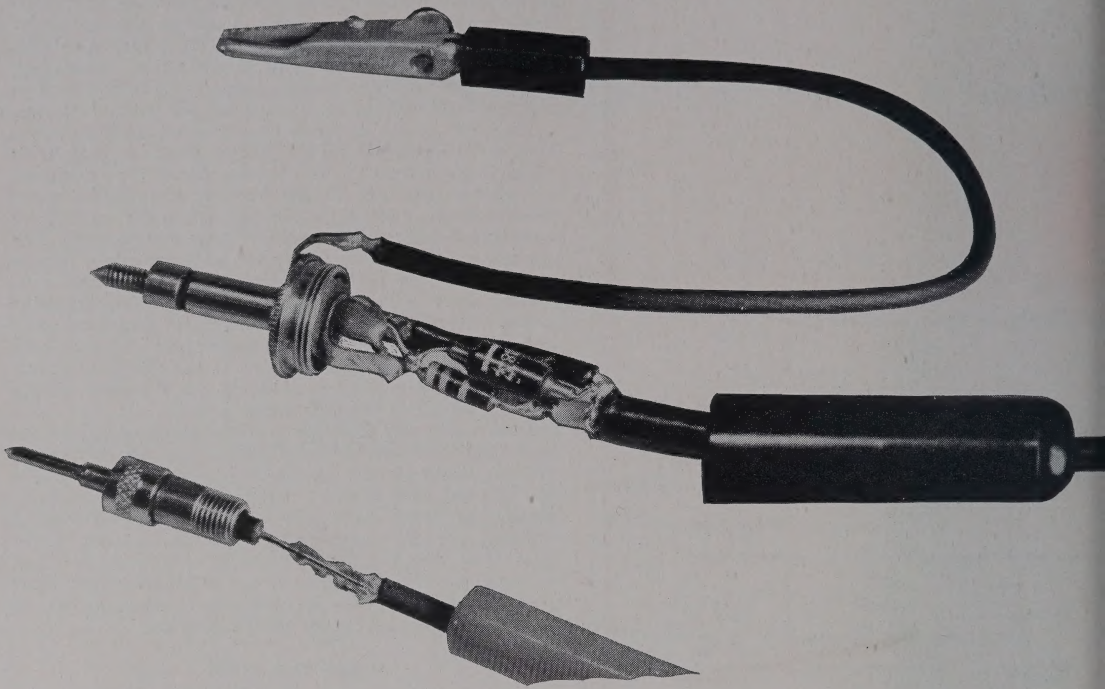
* **Heathkit**



For instance, the Q of a tuned circuit may be measured by using a GDO and VTVM. Using the RF probe, the VTVM is connected across the tuned circuit. The GDO is loosely coupled to the circuit and output frequency adjusted until a maximum reading is obtained on the VTVM. This frequency (f_1) can be noted by checking against a calibrated receiver. The GDO frequency then should be increased until the VTVM reading drops to 70.7% of its original value. Once again the frequency (f_2) should be noted by checking against the receiver. Then the GDO frequency should be set *below* f_1 at a point where once again the VTVM reads 70.7% of the peak value and this third frequency (f_3) noted on the receiver. Then:

$$Q = \frac{f_1}{f_2 - f_3.}$$

The balanced DC amplifier type circuit used in this Adapter is the type most often employed in commercially-built VTVM's. The 1-megohm resistor in the positive DC test lead is incorporated in the probe to minimize the capacity effect of the long test lead and thus allows the instrument to be used to make dynamic voltage measurements in circuits carrying oscillator or signal voltages.

Similarly, the crystal diode and associated rectifying components are built into the plug which forms the separate RF probe to provide low capacity to ground.

It is possible with a VTVM to measure AVC voltages in receivers quite accurately—a measurement not possible with conventional voltmeters because their comparatively low internal resistance will shunt out a high resistance AVC circuit. This AVC check, incidentally, makes a convenient point for obtaining an output reading when lining up the RF and IF stages of a receiver.

The operation of an oscillator can be checked over its intended frequency range by measuring the value of grid voltage at the oscillator tube socket while tu ing the circuit over its range.

Since the high impedance of the VTVM allows it be placed directly on the grid of a tube without se ously disturbing the circuit, it is possible to tell wheth or not a tube is gassy. A gassy tube will cause a positi voltage to appear across the grid resistor instead of t usual negative voltage. This same condition can exi however, due to a leaky coupling capacitor—so it wise not to discard a tube without first also checki the capacitor for leakage.

Because the loading effect of the VTVM is negligib it is possible to measure current without opening circuit to insert a milliammeter. The only requireme is the presence of a resistor of known value in the c cuit. In this case it is merely necessary to measure t voltage at each end of the resistor, subtract to find t voltage drop, and then apply Ohm's law to determi the current. In designing equipment, it is often qu feasible to insert 100-ohm resistors at certain poir especially for this purpose.

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SWEEPING *the* SPECTRUM

Another important insulation—which we neglected mention in our article on the subject last time—is icone rubber. This material has excellent properties, well as outstanding resistance to ozone, corona, sunht and heat.

For those who might wish to add this insulation to e table of statistics given in the May-June, 1954, ue of G-E HAM NEWS (Vol. 9, No. 3), here are the tings: Resistivity (ohm-inches), 10^{14} to 10^{16}; dielectric nstant, 3.0 to 3.5; power factor, 0.3 at 60 cy, 0.2 at mc; puncture strength of a 0.080-inch sample, 400 to 0 volts per mil. Silicone rubber is partly organic and rtly inorganic so fits neither of the two general classiations in the table accompanying our previous ticle.

While the electrical properties of silicone rubber are the same order of magnitude as organic materials at om temperature, they are greatly superior at high mperatures where "pure" organic materials can no nger be used. Silicone rubber is, of course, but one of large family of materials.

* * *

The silicones, incidentally, are something like the hmoo of comic strip fame. We mean nothing derogary in saying that. As you will recall, the schmoos uld do anything. And it's much the same with the licones. In fact, every article we've ever read on the licones has left us groggy and bewildered. For as the ory unfolds, we begin to forget the silicone uses that ere recited in the beginning.

Let's put it this way. Silicones are a new class of manade chemicals, combining the best qualities of sand, oal and oil. Their key material is silicon, which is deved from sand—the second most abundant element on rth. As a wartime development, the silicones were nder wraps for quite a while after the initial research the General Electric Research Laboratory in the 930's.

In its commonest form—a water-white oil—the mazing chemical can be poured in subzero cold and et survive heat up to 600 degrees F. As a "defoamer," nly a drop or two will burst millions of bubbles. As a lease agent, silicones keep rubber and plastic objects om sticking in molds. In paint, silicones can shrug f intermittent blasts of heat up to 1200 degrees F for 2 consecutive hours.

The various silicones are combinations of oxygen nd one or more hydrocarbon with silicon. By varying e proportions and types of hydrocarbons, the chemist an produce silicones ranging in stability and flexibility om volatile liquids to stable solids. They are used as preading agents in waxes and polishes, as water-reellents on insulation and textiles, as grease insulation n spark-plug terminals, and in many places where a on-corrosive seal is needed.

Scientists see in the future silicones replacing damaged vital parts of human tissue, silicone tires that will last the life of the car, silicone bunion pads and hygienic baby pants, stain- and spot-resistant clothes and—well, it does get bewildering. Think we'll try spraying a drop or two into the atmosphere to see if it will dispel the QRM.

* * *

A dozen 10-meter mobiles from these parts went out to a nearby reservoir one recent week end and provided communications for a "carp-shooting contest." The shooting was done by bow and arrow and scoring kept up-to-the-minute by five mobile stations reporting in to a HQ station. Ham radio came in for quite a bit of praise and a trophy was awarded the hams for their work. The boys' big question now is what are they going to do with the trophy? Who's going to keep it? They don't all belong to one club. They can pass it around for a while. Then what? Any suggestions?

* * *

To succeed in amateur operating a fellow has to develop a fairly high degree of patience, as old timers know very well. A recent example of this was brought to our attention when a ham we know attempted to contact a friend of a visitor in his shack. No sked had been arranged but the ham knew the other fellow often was on the air near a certain frequency around 8 o'clock at night. While the visitor sat and waited without much hope of making the contact, our friend alternately combed the specified frequencies, called a few times and alerted several other hams working nearby. Pretty soon they heard someone testing—and there was the contact. The visitor was much impressed—but our friend thought nothing of it.

Another example of ham patience is reported in a recent issue of the Rochester (N. Y.) Amateur Radio Association Rag. W2SAW followed the Clipperton Island expedition for days and then started to call them at 6:30 one morning. He called constantly until the following morning at 2:45 when he made the contact.

* * *

Our editor thinks he may have received one of the last QSL cards from Nicaragua—at least for a time. He got a card from a YN1—who he worked on 75-meter SSB with a 10A and 6146—together with a letter which said the YN1's were off the air due to "some internal difficulty." A week or so later the news broke about arms shipments from Czechoslovakia to neighboring Guatemala—which our editor thinks probably had something to do with the "internal difficulty."

—Lighthouse Larry

Technical Information

SLICING UP ELECTRONIC TUBES

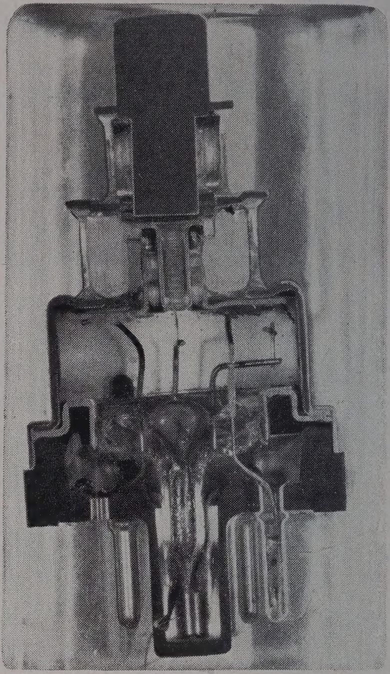
What spacing exists between the components of a tube after it is put together? Breaking sample tubes open and and looking at them is unsatisfactory because the disassembly process could disturb the placement of the elements.

G.E. solves this inspection problem by filling samples from the production line with plastic—and then slicing the tubes cross-wise and/or length-wise to check the spacing of elements.

In some cases, the tube is immersed in a clear liquid plastic, and the glass tip broken off. Because of the vacuum inside the tube, normal atmospheric pressure forces the liquid plastic into the tube. In other instances, a hole is drilled in the tube (see hole in cap of the 2C39-A illustrated) and tube evacuated again in a special vessel which also contains the plastic liquid.

Chemical action and baking harden the plastic in a few hours with the elements undisturbed. Then the glass envelope can be cracked away, and the plastic-encased elements sliced into sections and polished for study under a microscope.

Careful inspection of the illustration will reveal the filament, grid and even the solder in one pin—just as they actually ended up in a finished tube.



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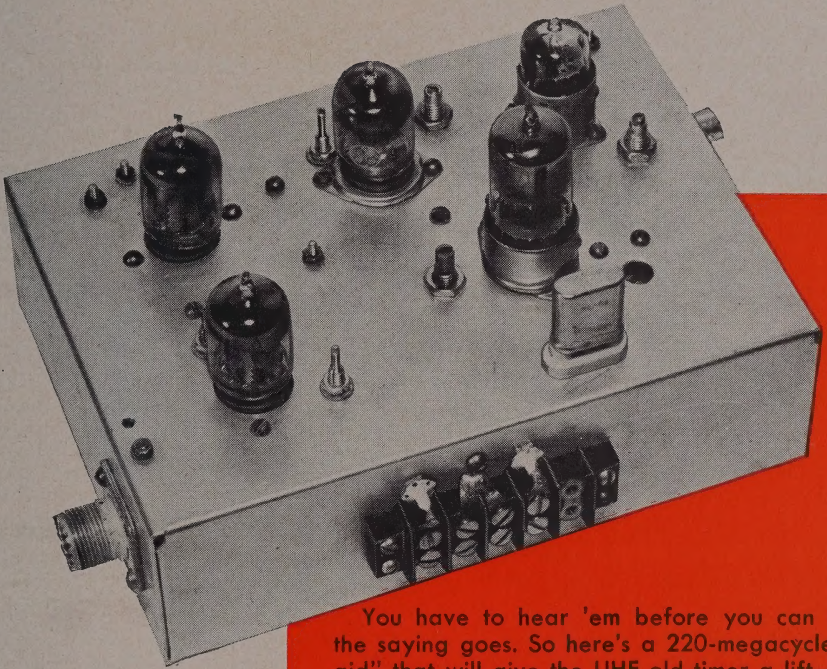
SEPTEMBER–OCTOBER, 1954

VOL. 9–NO. 5

Low-Noise 220-Megacycle Converter



You have to hear 'em before you can work 'em, the saying goes. So here's a 220-megacycle "hearing aid" that will give the UHF old-timer a lift—and give the UHF tyro a good start. It's a 220–225-megacycle crystal-controlled converter that feeds a 10–15-megacycle signal into a communications receiver. Take a look, fellows.

—*Lighthouse Larry*

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220-MEGACYCLE CONVERTER

CIRCUIT DESCRIPTION

This 220-megacycle converter uses 6AJ4 and 6AM4 type tubes developed by General Electric especially for high-frequency service. As shown on the circuit diagram, two stages of radio frequency amplification are used. These are 6AJ4's in grounded grid service rather than in cascode circuits because of the relative ease in getting the circuits into operation. Performance does not seem to be impaired, because the noise figure was found to be between 5 and 6 db. In addition, the circuit is not critical to adjust.

A 12AT7 is used as a fixed oscillator, the first stage operating at 70 megacycles with an overtone crystal in a Butler-type circuit. The second half of the 12AT7 triples to 210 megacycles, and this frequency is injected into the 6AM4 mixer by means of a 1 micro-microfarad coupling capacitor. The resultant intermediate frequency varies from 10 to 15 megacycles, depending upon the frequency of the signal being received. The 220- to 225-megacycle amateur band thus is covered by tuning the station receiver between 10 and 15 megacycles.

Two Butler-type circuits were built, both using a 70-megacycle overtone crystal, and each oscillated satisfactorily. If a lower oscillator crystal frequency is to be used, it will be necessary to rearrange the circuit and add another multiplying stage. In this event, a 7.77-megacycle crystal could be used in a stage which picks off its third overtone of approximately 23 megacycles—and then multiplication continued to 210 megacycles as in the circuit described here. The oscillator circuits were set up initially with a grid-dip oscillator and required some later adjustment in tuning and coupling to optimize performance. The variable capacitors specified allow plenty of tolerance for circuit variations.

The 6AM4 mixer stage is a grounded cathode circuit. This tube has five grid pins, and no trouble was encountered in using two of these pins. The three unused grid connections were removed from the socket to minimize stray capacitance. A single-stage IF amplifier uses slug-tuned coils and a 6AK5.

The converter requires from 125 to 150 volts of B plus rated at 50 to 60 milliamperes and a 6.3-volt filament source that will handle 1.2 amperes. Both the filament and high-voltage leads are by-passed at the terminal block by feed-through capacitors (C_{25} and C_{26}) to prevent possible interference from a strong shortwave station at the IF frequency which might enter the converter through the power connections. If such a station is nearby, it may be necessary to cover the 6AM4 and 6AK5 and use a bottom plate on the chassis. Such precautions prevent frayed nerves when trying to copy 220 DX.

NOISE PERFORMANCE

As always at these frequencies, noise is an important factor and considerable success was experienced in reducing this figure.

In the VHF and UHF range the ultimate sensitivity of a receiver or converter is limited by its noise figure. It is important to reduce noise figure as low as possible. If the noise figure is reduced from 15 db (a not uncommon figure) to 5 db, it has the same effect as raising by 10 times the power output of the station sending to the receiver. The 6AJ4 and 6AM4 tubes were designed to provide top performance at the UHF television range, and they perform beautifully at 220 megacycles.

A noise generator should be used to optimize performance. Such circuits have been described numerou times in amateur publications, and the circuit of th one used to set up this converter is shown in Figure 1

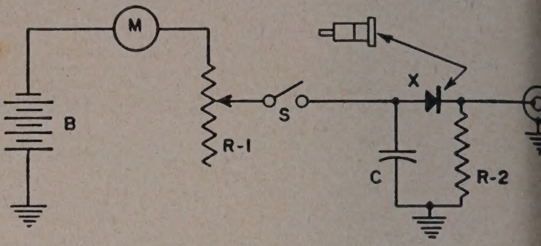


Fig. 1—Home-built noise generator uses a 0 to 2 ma meter

C—.001 mfd ceramic disc or tubular
R_1—10,000-ohm potentiometer
R_2—56 ohms, ½ watt
X—silicon diode (1N22 or 1N23)
M—0-1 or 0-2 ma d-c meter
B—3 volts

A silicon crystal diode must be used and the one show here is a surplus 1N23 held into the circuit with a fus clip and a pin taken from an octal socket. The tim spent in constructing such a noise generator will b more than made up in optimizing performance of th converter.

The general procedure used for this converter wa to first set it up for maximum gain (as measured a the detector of the station receiver) with a signa generator that will put out a 220-megacycle signal After this was done the noise figure of the converte was measured on a laboratory-type noise generato and found to be 9 db. Then the home-built nois generator was connected to the receiver, and adjustments made as described below until optimum nois performance was obtained.

When finally checked against a laboratory-typ noise generator, the noise figure was between 5 and db—fairly respectable performance at 220 megacycles It should be noted that optimum noise figure is no necessarily obtained at the point of optimum gain Thus, in the absence of laboratory-type noise generator which can actually measure the noise figure, it i important to adjust for minimum noise figure on th home-built noise generator rather than for maximun gain.

PRELIMINARY CONSTRUCTION

Construction is not difficult, but should closely follo the layout and wiring of the model illustrated. Th converter contains a total of 55 parts to be wired in— that is, capacitors, resistors and coils. This average only about nine parts for each of the six stages—an only five of the connections are particularly critica The accompanying illustrations have been carefull made with a view to assisting the reader in followin the construction as closely as possible.

A 5x7x2-inch aluminum chassis should be laid o according to Figure 4—although slight variations a permissible to accommodate the actual parts the build has gathered. It is wise to have on hand all the necessar parts—including the coils—before starting constru tion. Care should be taken to drill tube socket-moun ing screw holes so that sockets will be properly oriente

After the chassis is drilled and punched, the follo ing parts can be mounted: RF connectors, termin block and its feed-through capacitors, crystal socke IF coil forms, the 4-30 micro-microfarad ceram trimmer, the tubular ceramic trimmers, the variab air capacitor, and the four tie-points which suppo e RF chokes and the 100-ohm decoupling resistors. iniature ceramic stand-off insulators made by mbridge Thermionic Corporation are used for this ter purpose in the model shown, but ordinary 1- or point terminal strips will serve.

Before mounting the tube sockets, some of the un-ed lugs of the tube sockets of the first RF stage and e mixer stage are removed to reduce stray capacity. the first 6AJ4 stage, tube socket lugs 1 and 3 should removed; and in the 6AM4 stage tube socket lugs 3 d 6 should be removed. This operation is easily ac-mplished by flattening the locking dents in the lugs th a pair of long nose pliers and then pushing them t through the top of the socket.

When mounting the tubular ceramic trimmers (C_1, , C_7 and C_{10}), note they should be oriented so their gs can be soldered directly to the tube socket lugs.

Small strips of copper about 3/16-inch wide are shioned for soldering between pins 4 and 9 of the st 6AJ4 socket, and between pins 1, 3-4, 6 and 9 of e second 6AJ4 socket. As shown in Figure 5, these ields are connected to the base sleeve of the socket.

COIL WINDING DATA

While coil specifications in the components list companying the schematic diagram are complete, it ight be well to mention that L_6 and L_7 can be ound on any type form as long as the finished product, the circuit, tunes the IF frequencies of 10 to 15 egacycles.

After winding RFC_{1-4} and L_3 on the threads of a -20 bolt, it is possible to carefully unscrew the bolt om the coils without disturbing the spacing. It is se to leave the leads longer than necessary until ady to wire the coils into the circuit.

WIRING DETAILS

The filament leads, RF chokes and high-voltage ads can be wired first. Wiring of the remaining mponents should follow—with the exception of C_5, , and C_{22} and the input lead from the RF connector the cathode of the first 6AJ4. Care should be taken keep RF leads as short as possible.

In wiring, note the placement of C_{11} and C_{12} on ch side of pin 2 of the 6AM4 socket. Two capacitors e used here to reduce lead inductance. In the model own (Fig. 5) two 200-ohm resistors are used for R_8—one connected to pin 2, the other to pin 7 (both cathode pins) of the 6AK5. One 100-ohm resistor connected to either pin will serve, however.

Connection of C_5, C_9 and C_{22} and the RF input lead to their associated coils is somewhat critical for optimum noise figure and the adjustment procedure is described below.

ADJUSTMENT PROCEDURE

The home-built crystal diode noise generator does not give noise figure in actual db. It is a comparison device only, and merely tells the experimenter whether the adjustments he makes on his converter are in the right direction. With the particular crystal and components used in the home-built noise generator shown, it was found that 1 milliampere of reverse crystal current—indicated on the noise generator meter—is equal to approximately 10 db of noise when compared with a laboratory noise generator.

Unless the builder has access to such a laboratory instrument, he will not be able to measure precisely the noise figure of his converter. However, if the construction and adjustment instructions are closely followed, he can be sure that when he has attained optimum performance as indicated with his own home-built noise generator, the noise figure of his converter will be comparable to the converter described herein.

The adjustment procedure for obtaining the best noise figure involves moving the connections of the RF input lead, C_5, C_9 and C_{22}. Of course, before these adjustments can be made, these components must be soldered in to check voltages and set the converter up for maximum gain. It is suggested that as a starting point, the RF input lead from the antenna connector be soldered directly to the cathode pin of the socket of the first 6AJ4. The connection of C_5 to L_2 can be made at the center of L_2. Then C_9 can be soldered from a point about a half-turn down from the plate end of L_2 directly to pin 9 of the 6AM4. C_{22} can be connected between grid pin 4 of the mixer tube and tapped down about a half turn from the plate end of L_{10}.

With these connections made, the first step is to use a signal generator as mentioned above—or a fellow ham's 220 mc transmitter—and make the usual adjustments of the tuned circuits to get maximum gain. Once this is accomplished, the objective of subsequent ad-

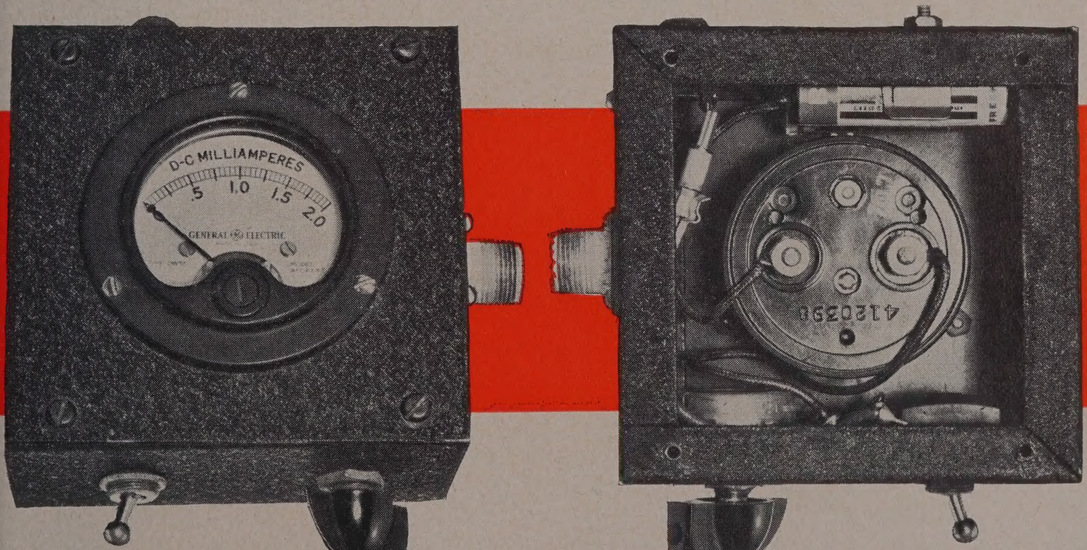


Fig. 2—Two penlite cells supply power for the noise generator

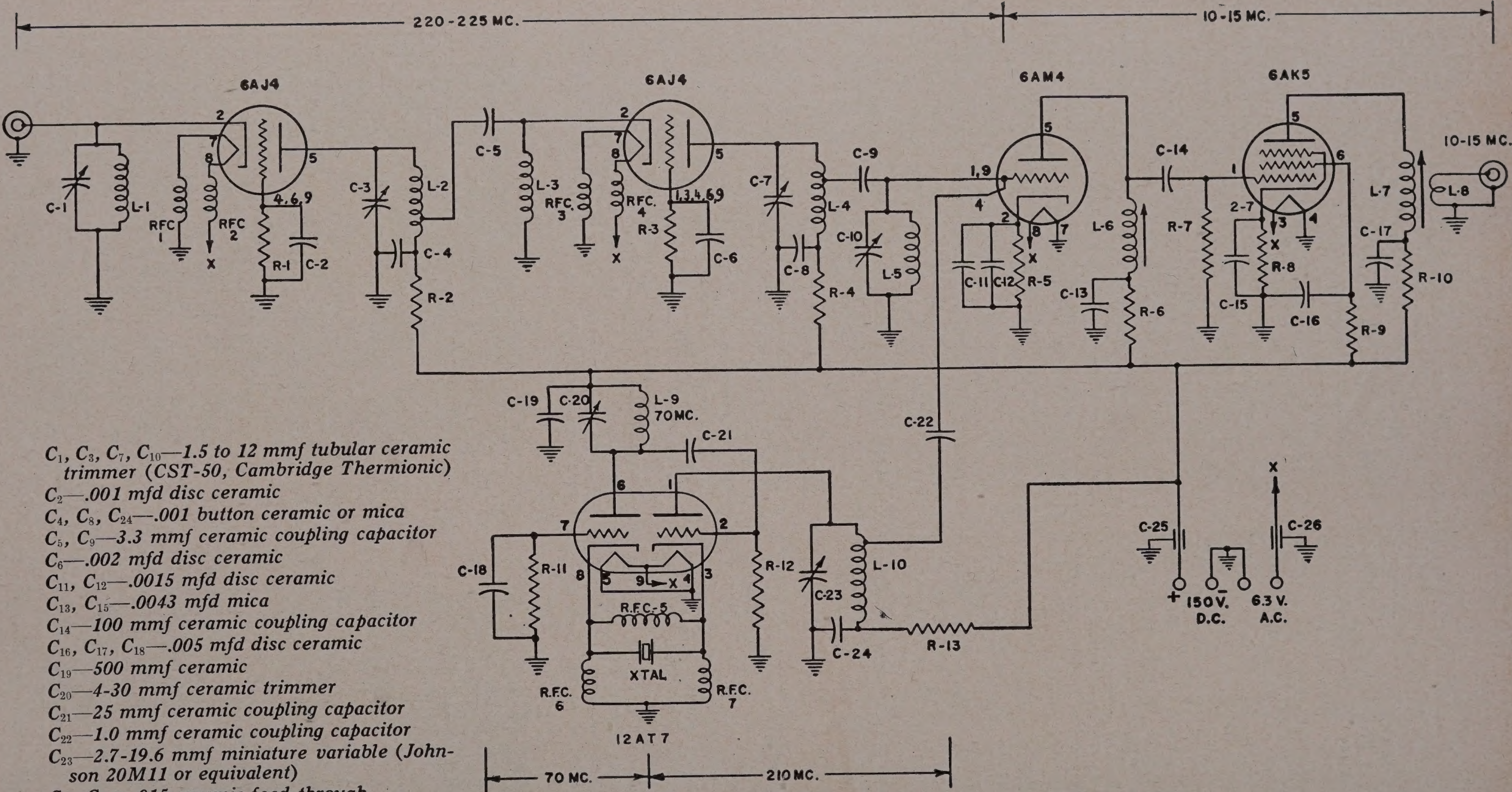

220-225 MC.
10-15 MC.
6AJ4
6AJ4
6AM4
6AK5
10-15 MC.
C-1
L-1
RFC 1
RFC 2
X
R-1
C-2
4,6,9
C-3
L-2
C-4
R-2
C-5
L-3
RFC 3
RFC 4
R-3
1,3,4,6,9
C-6
C-7
L-4
C-8
R-4
C-9
C-10
L-5
1,9
C-11
C-12
R-5
L-6
C-13
R-6
C-14
R-7
2-7
R-8
C-15
C-16
R-9
L-7
L-8
C-17
R-10
C-19
C-20
L-9
70 MC.
C-21
C-22
C-18
R-11
R.F.C.-5
XTAL
R.F.C. 6
R.F.C. 7
12AT7
R-12
C-23
L-10
C-24
R-13
C-25
C-26
+ 150 V. D.C.
6.3 V. A.C.
70 MC.
210 MC.

Fig. 3—Circuit diagram of 220-megacycle converter

C_1, C_3, C_7, C_{10}—1.5 to 12 mmf tubular ceramic trimmer (CST-50, Cambridge Thermionic)
C_2—.001 mfd disc ceramic
C_4, C_8, C_{24}—.001 button ceramic or mica
C_5, C_9—3.3 mmf ceramic coupling capacitor
C_6—.002 mfd disc ceramic
C_{11}, C_{12}—.0015 mfd disc ceramic
C_{13}, C_{15}—.0043 mfd mica
C_{14}—100 mmf ceramic coupling capacitor
C_{16}, C_{17}, C_{18}—.005 mfd disc ceramic
C_{19}—500 mmf ceramic
C_{20}—4-30 mmf ceramic trimmer
C_{21}—25 mmf ceramic coupling capacitor
C_{22}—1.0 mmf ceramic coupling capacitor
C_{23}—2.7-19.6 mmf miniature variable (Johnson 20M11 or equivalent)
C_{25}, C_{26}—.015 ceramic feed-through
R_1, R_3—.5 megohm
R_2 R_4, R_8, R_{13}—100 ohms
R_5—56 ohms
R_6, R_{10}—1000 ohms
R_7—7500 ohms
R_9—3000 ohms
R_{11}—10,000 ohms
R_{12}—20,000 ohms
L_1, L_2, L_4, L_{10}—3t. No. 14 wound on ½-inch d. form, ⅜-inch long

L_5—3t. No. 14 wound on 3/16-inch form, ⅜-inch long
L_6—35t. No. 30 en. close-wound on ½-inch slug-tuned ceramic form (CTC-LS7)
L_7—40-45t. No. 30 en. close-wound on same type form as L_6.
L_8—4t. link insulated wire on cold end of L_7.
L_9—5t. No. 14 wound on ½-inch form, ½-

RFC_{1-4}—12t. No. 24 en. wound in threads of ¼-20 bolt
RFC_5—5t. No. 24 en. close-wound on a ⅞-inch length of ¼-inch d. polystyrene rod
RFC_{6-7}—35t. No. 30 en. close-wound on a ¾-inch length of ¼-inch d. polystyrene rod
XTAL—70-megacycle overtone-type crystal (Midland or equivalent).

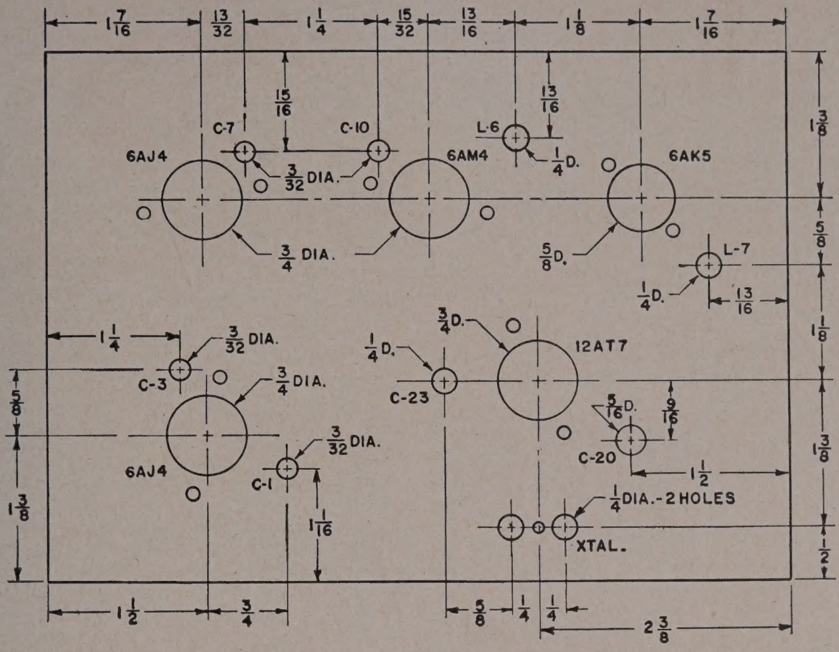
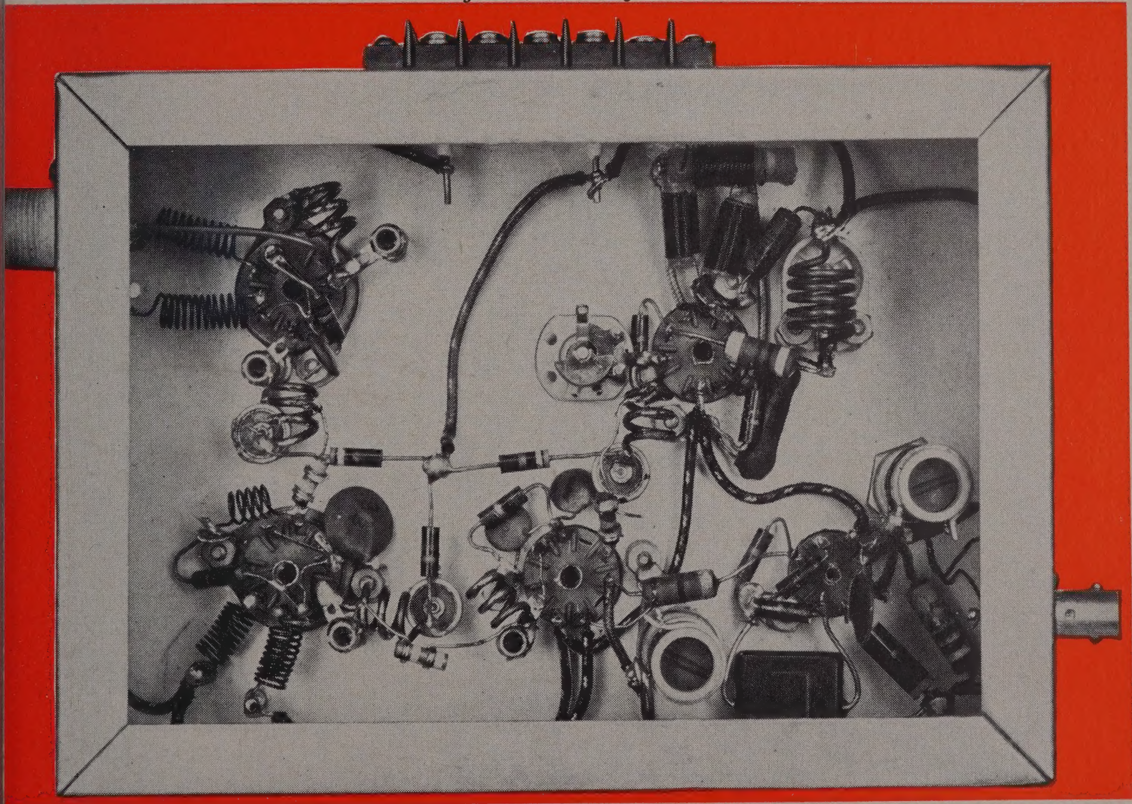

1 7/16
13/32
1 1/4
15/32
13/16
1 1/8
1 7/16
15/16
13/16
C-7
C-10
L-6
6AJ4
3/32 DIA.
6AM4
1/4 D.
6AK5
1 3/8
3/4 DIA.
5/8 D.
5/8
L-7
1/4 D.
13/16
1 1/8
3/4 D.
1 1/4
3/32 DIA.
1/4 D.
12AT7
C-3
3/4 DIA.
C-23
5/16 D.
9/16
5/8
3/32 DIA.
C-20
1 3/8
6AJ4
C-1
1 1/2
1/4 DIA.-2 HOLES
1 3/8
1 1/16
XTAL.
1/2
1 1/2
3/4
5/8
1/4
1/4
2 3/8

Fig. 4—Chassis layout



g. 5—Bottom view of 220-megacycle converter. RF put at top left, second RF amplifier at bottom left rner; mixer tube and slug-tuned plate coil (L_6) bottom center; and IF amplifier and final tank coil ($_{7-8}$) at bottom right. At top right is crystal socket, the 12AT7, C_{20}, C_{23} and other components associated with the oscillator circuit. The 6AM4 plate resistor and plate by-pass are hidden under the lower lip of the chassis. In this view most of the parts can be identified by checking their connections to tube pins.

justments is to improve the noise figure. As mentioned earlier, the converter gain may decrease slightly—but the real test is in the noise figure; so no further gain adjustments should be made as they would upset noise performance.

Before starting the noise performance adjustments it will be necessary to set up a circuit to measure output in the station receiver with which the converter is to be used. One method is to remove the receiver detector tube and use the proper socket pin to take off the signal from the last IF transformer, rectify the current therefrom either with a germanium or vacuum tube diode and measure noise at this point with a milliameter or vacuum tube voltmeter. (While it would be possible to use the receiver detector for this rectifying job, in most cases the AVC circuit also is hooked on at this point and would complicate matters.)

It is also possible to connect a milliameter or vacuum tube voltmeter to the secondary of the output transformer, providing there is a 500-ohm output tap Ordinarily, an 8-ohm audio output will not provid enough voltage to measure conveniently.

Now the noise generator should be connected to th receiver by a short length of coaxial cable and th receiver and converter turned on. With the nois generator off, the receiver RF gain control should b set at a point where internal noise registers about milliampere on the output meter attached to th station receiver. After this reference level is establishe the receiver RF gain control should not be touche again during the noise performance adjustment procedure.

The next step is to turn on the noise generator an adjust its potentiometer so that the generator mete reads about mid-scale. (On the noise generator show this would be 1 milliampere.) Now note the percentag of increase in the output meter reading as compare with its reading when the noise generator is off.

From here on the object is to make changes in th converter's input and coupling circuits which will result in this same percentage increase in the outpu meter reading—but with lower and lower readings o the meter in the noise generator.

What happens is this: As the amount of nois generated in the converter itself is reduced by adjus ing the input and coupling between stages, a smalle and smaller amount of external noise injection is required to activate the output meter on the receiver i the same proportion.

The first adjustment to make on the converter t improve noise performance is to find the best poin on L_1 to attach the input lead from the coaxial connector. In the converter shown, it was found th best tap position actually was right at the cathod tube pin. It is quite possible that in some other mode optimum performance will be obtained with this inpu lead tapped down on the coil.

The following procedure should be used to dete mine the correct point to tap the input lead: Ever time the input lead is moved so that it changes th percentage of increase on the output meter when th noise generator is turned on, the potentiometer on th noise generator should be adjusted to bring the outpu meter reading to a point where the percentage of increase on the output meter is the same as it was befor the adjustment procedure was started. If the co tap adjustment was in the right direction, the nois generator potentiometer adjustment should reduce th reading on the meter in the noise generator. If, however, obtaining the same percentage of increase accomplished by increasing the noise generator cu rent, the coil tap adjustment was a step in the wron direction.

The next adjustment to make is the tap on L_2. Th lead from C_5 should be soldered on the coil at variou points—each time readjusting the noise generat potentiometer to see if the noise generator curren goes down when obtaining the same increase on th output meter. In the converter shown, optimum pe formance was obtained with C_5 tapped almost exact at the center of L_2.

The third important adjustment is the amount oscillator voltage injection. This can be changed b trying various values of coupling capacity (C_{22}), an also by moving the tap on L_{10}. In making these adjustments, the same procedure outlined above followed. The converter shown hit optimum performance with a 1 micro-microfarad coupling capacit tapped about a half turn down from the plate end L_{10}.

Adjustment of C_9 did not seem to make much di ference in noise performance in the converter show However, it might be worth while trying tapping th leads of this capacitor at different points on L_4 and L_5

Tricks & TOPICS

RESTORING CRACKLE FINISH

Tops of metal cabinets often become dingy and unsightly with age. These surfaces are not readily cleaned with water or furniture polishes. A few experiments in my ham shack have resulted in a simple solution to this problem. Apply with a cotton cloth a few drops of mineral oil to the dull crackle surface. Wipe off excess oil by hard rubbing with a clean cloth. Automotive oil such as No. 20 or 30 is excellent for the purpose. The original sparkle and uniformity of the finish will thus be obtained. Try it and you'll be amazed.

—Robert E. Burnett, W2YIV

HOW TO GET G-E HAM NEWS

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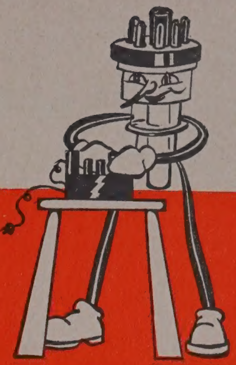
PARASITICS

In the schematic diagram for the VTVM Adapter described in the July-August, 1954, issue of G-E HAM NEWS (Volume 9, No. 4) a chassis-ground connection in the negative (black) lead circuit was not indicated. While this omission will not affect the d-c operation of the instrument, such a ground is necessary to provide a return path for RF when using the RF probe with the chassis-grounded connector indicated.

SWEEPING *the* SPECTRUM



Several people have remarked, after reading about : Edison Radio Amateur Award winner and the nners-up who received special citations, that they ow someone who also rendered an outstanding blic service. In each case, however, no one took the uble to nominate the amateur in question. Thus work went unnoticed by the judges of our Award. in most such awards, one of the biggest jobs is nting for Award candidates. This is especially ie with amateur radio awards because for the most rt amateurs are modest individuals. So if you know an amateur you feel worthy of the Edison Radio nateur Award, be sure to nominate him. The rules the Award are given in our advertisements in the ptember and October issues of both CQ and QST gazines.

* * *

W0NPA apparently found there are no secrets in a m wedding—what with mobiles all over the place porting your every movement. "Ham Hum," pub- hed by Ak-Sar-Ben Radio Club (W8EQU), reports biles were stationed at the church and at the happy uple's "hidden" get-away car.

* * *

A note in "Sparks," published by the Brandon lanitoba) Amateur Radio Club, informs us that E4PA visited VE4WW and VE4SB and "spent a uple of fruitless hours watching the snowflakes on ordon's 21-inch video screen." Also, "Gordon (VE- VW) is quite happy over three and a half minutes of ansmission from Memphis a week ago last something- -other. Anyway it's a nice piece of furniture." me of us in the "more advanced" TV locations are ondering if the lads up that way know really how ell off they are!

* * *

"Show me a man who has a hobby and I'll show you conscientious man whose effort and success is above erage. Of all the hobbies, it is safe to say ham radio the most complete both politically and technically. o other hobby can serve the public as adequately as n ham radio. Probably no other hobby has as many alous commercial interests eyeing our assets. No her hobby can or has helped the advance of elec- onics as ham radio has done."

Thus writes W9YME in "Marc Sparks," published y the Michiana Amateur Radio Club (W9AB). He lds that none of these achievements can or could be complished without the co-operative efforts of in- vidual hams organized into clubs. Individually, he points out, we are but persons with hobbies; collectively, we constitute a powerful force that can help not only ourselves but our community, our nation and the world. And I might point out all that is in addition to the fun and fine friendships club activities can bring.

* * *

Our first Bound Volume was so popular, we are getting a lot of requests for a second Bound Volume. The first volume contained all the issues of G-E HAM NEWS published from 1946—when G-E HAM NEWS began—through 1950. We plan to make up another bound volume at the end of our second five-year period of publication. Thus our second Bound Volume will contain all issues published in the years 1951 through 1955.

We're sorry it is so long between Bound Volumes, but publishing bi-monthly as we do, it takes that long to accumulate sufficient issues to make binding worthwhile. If by any chance any of you wish to make reservation at this early date for the second Bound Volume of G-E HAM NEWS, we'll be glad to keep your name and address on file until the book is ready. *But please do not send any money now!* We sell the Bound Volumes at the cost of binding and handling (the first one cost $2 per copy) and we cannot tell at this time just what binding will cost a year and a half from now.

* * *

The editor was looking over ARRL's bibliography of TVI literature the other day and reminded us to remind you that we still have some back copies of the issue of G-E HAM NEWS which described our "TVR High-Pass Filter." This highly effective filter for a TV receiver input incorporates an interesting design feature and for a very few cents can be put together in a matter of minutes. It appears in the March-April, 1951, issue of G-E HAM NEWS (Volume 6, No. 2). I'll be glad to send you a copy, if you want one. Incidentally, one of the fellows who used one of these little filters reported it was highly effective as a fuse when lightning struck his TV line. He said the filter just seemed to evaporate. He couldn't find more than a few droplets of copper left. But the TV set was still there. We don't recommend the filter as a substitute for normal lightning arresting precautions, however.

—*Lighthouse Larry*

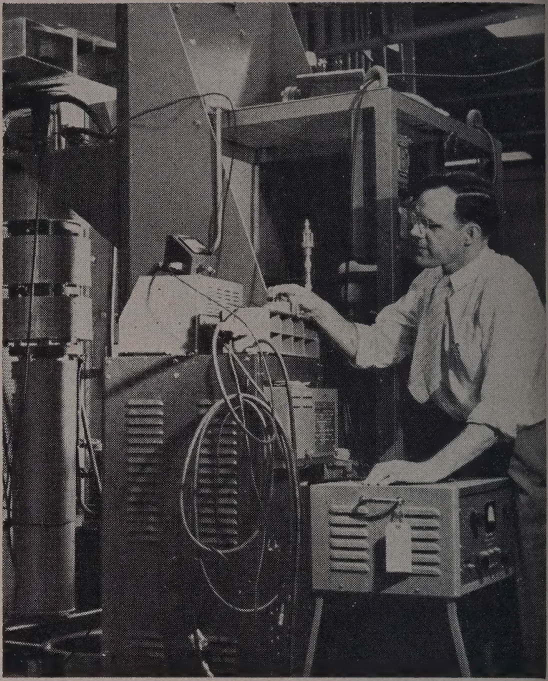
UHF DXpert

A. R. KOCH, W2RMA

Art Koch, W2RMA—designer of the 220-megacycle converter described in this issue of G-E HAM NEWS—makes G-E UHF klystrons tick during the day. Then he goes home and makes UHF ham rigs tick. He's a design engineer at the industrial and transmitting tube plant in Schenectady and has supervised the installation of UHF klystrons in a number of the nation's most progressive TV stations.

G.E.'s 12-kilowatt klystrons come in six types—each covering a segment of the 470 to 890-megacycle UHF TV band. They are tunable within their ranges and are triple-resonator type tubes. Klystrons stand about five feet high, draw 35 amperes of heater current at 5.5 volts, and require 17,000 volts d-c at 3 amperes. Driving power averages 25 watts—and most stations use a 4X150 as driver. Two klystrons are used in a UHF-TV station—one to amplify the visual signal, the other to amplify the sound—and the two are mixed in a "Filtrexer" before being fed into the antenna.

Art, shown here setting up some gear to test a klystron, is the designer of one of the UHF cavities illustrated in the ARRL Handbook, and the Super 430 (G-E HAM NEWS, Volume 8, No. 4).



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NOVEMBER–DECEMBER, 1954 VOL. 9–NO. 6

600-WATT ALL-BAND AMPLIFIER

Push-pull 813's Ease Your Steps to Higher Power

There's no "easy" way to power—but this amplifier, designed and described by W2GYV, employs tested techniques and standard components to make the road to power as smooth as possible.

—*Lighthouse Larry*

Deadline for nominations for the Third Annual Edison Radio Amateur Award is January 3, 1955 . . . Pick a candidate and send in your nominating letter . . . see page 8.

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600-WATT ALL-BAND AMPLIFIE

GENERAL DESCRIPTION

Here's a husky all-band final that does not utilize any new or trick circuits or any substantially different mechanical layout. It will be recognized from the circuit diagram and photographs as a conventional push-pull tetrode amplifier constructed in a straightforward manner. It illustrates the use of modern components and practical design.

In this complicated age, there is much to be said for an occasional attempt at simplification; and those seeking a respectable amount of power may find this amplifier fills their needs without emptying their pocketbooks or fraying their nerves during construction and testing.

The amplifier employs a pair of GL-813 tubes in a neutralized push-pull circuit. A multiband grid tank allows the input circuits to be permanently shielded and simplifies band-changing. The plate circuit uses standard plug-in coils which are easily accessible for band changing through the shielded and RF weather-stripped panel door.

No metering is provided in the amplifier itself. The incorporation of meters would make shielding and circuit isolation more difficult. It is much simpler and forthright to install grid, screen and plate current meters in a standard three-hole panel mounted elsewhere in the rack and connected in the power leads going from the amplifier after all RF has been filtered from them.

A regulated bias supply is included in the unit since with the low grid currents encountered it can be a simple affair and is something that would probably have to be built up in any event.

All controls, including input and output coupling, are conveniently located on the front panel. Coaxial connectors are used for the RF input and output and HV plug connectors for plate and screen leads. The grid meter and interlock circuit connections are made with two-contact microphone plugs mounted under a small shield on the rear of the chassis—thus making it a short and easy operation to disconnect all leads and remove the amplifier from its rack. The AC input—for bias and filament power—is through a cord and plug leading to the control unit shown in G-E HAM NEWS of March-April, 1954. (Volume 9, No. 2).

CIRCUIT DETAILS

The only part of the circuit which may be out of the ordinary is the use of a four-section variable capacitor, C_{12}, in the plate tank. This capacitor is adapted from a standard unit as explained under the constructional details and allows optimum L/C ratio to be achieved on all bands. It also makes tuning less critical on the three highest bands. The proper sections of the capacitor are selected automatically by jumpers on the coils between pins 1 and 2 and 7 and 8.

The plate coils are standard 500-watt units and although the amplifier has been run for extended periods at inputs of over 600 watts no undue heating of the coils was experienced. Jacks 3 and 6 on the coil socket were not used in this design.

The output is through a shielded link as specified. These links are available in 1, 2, and 3 turns. Generally, a 1-turn link is considered satisfactory at 10 meters, a 2-turn link at 15 and 20 meters, and a 3-turn link for 40 and 80. However, during tests, a 2-turn link was found satisfactory for all bands when working into a 52-ohm coaxial line. Experimentation is recommended here as each antenna system may be slight different. What works at one installation may not wo well at another, even though the same general syste is used, since one line may have a different standi wave ratio than the other. At any rate, link coupling this sort is probably the easiest of all coupling devic to adjust.

The vacuum capacitors C_6 and C_{11} are for the purpo of providing a short low impedance path for the high harmonics which might cause TVI. It should be pointe out that they are not necessary to the normal sati factory operation of the amplifier and may be omitte if TVI is not a problem.

Don't be misled, however, into thinking that the capacitors themselves will be a complete cure for a TVI. They are an aid in stubborn cases and you ma well want to try the amplifier before installing then However, the vacuum capacitors are part of the tot plate tank capacitance and the coil modifications give in the coil table are based on their use. Leaving the out may not necessitate the coil modifications liste under "Coil Data."

The neutralizing capacitors, C_2 and C_5, were foun necessary to completely stabilize the amplifier. A normal checks failed to reveal the need for neutralizin but on checking the amplifier for stability by operatin it at zero bias, no RF drive, and with plate and scree voltages adjusted to give rated static plate and scree dissipation, it was found that a weak oscillation woul occur when both grid and plate were tuned to the sam frequency. The neutralizing wires were then adjuste until this did not occur. This should be done with th 10 meter coils in place and will then hold for all-ban operation. The neutralizing wires are made from N 14 copper wire and are brought through the chass approximately one inch from the tubes. Small cerami feed-through insulators were used for this purpos Start off with wires reaching to the tops of the tub anodes and adjust them by clipping off ½ inch at time until a length is found which will give complet neutralization. Fine adjustment is made by changin the spacing between wires and tubes by means of a insulated rod through the ¼-inch holes in the back the shield.

The bias supply is conventional. It utilizes a GL OA3/VR75 tube for regulation and so furnishes 7 volts of fixed bias. The remaining bias is develope across R_1 by the flow of grid current. This resistor may seen in the photographs on top of the bias supply su chassis. The remaining resistors and selenium rectifi are mounted under this sub-chassis. The 75 volts more than sufficient for plate current cutoff, allowin the driver to be keyed for CW work provided th screen is supplied from a fixed supply or from a volta divider from the HV plate supply. Do not attempt C operation if the screen is supplied through a droppin resistor.

Liberal use has been made of by-pass capacitors an RF chokes. All of these precautions make for stabl trouble-free operation and are well worth their cost.

An interlock switch S_1, is provided to protect t absent-minded when changing coils. It should be co nected in the power supply in such a manner that t primary voltage to the plate supply is removed wh the door is opened. The micro-switch used is a SPD switch and should be connected so that the swit opens the circuit when the door is open. In additio provision should be made for shorting the high volta ad to discharge the filter capacitors before changing ils. Make up a shorting stick NOW. AND USE IT! fellow isn't even allowed one mistake at these ltages!

MECHANICAL DETAILS

Much thought and time was given trying to evolve me novel and suitable mechanical layout—something at would be eye-catching and efficient. In fact, the hole project was delayed several months because of is. Several unique ideas were dreamed up but disrded because they were too expensive, too difficult to nstruct without metal-working facilities or else they st shouted over-design.

The old standby of chassis and panel construction oved to be not only the easiest to handle with the ual facilities but also promised to fit into most odern station layouts.

The biggest problem (and it was small compared to me of the layouts that were considered) was that of tting the plate tank capacitor and link controls out the front panel. The solution was found with standd components. The capacitor is driven with a rightgle drive unit, two universal joints, and some ¼-inch ameter shaft. Panel bushings are used wherever the aft goes through the chassis or panel. The link control quired only two flexible shafts. The arrangement ould be evident by inspecting the photographs.

The parts layout is also clearly shown and no tailed drawings are given. The multiband tank is ounted on spacers so the tuning and link shafts are ntered on the lower section of the front panel.

The bias supply is built on a separate sub-chassis sily shaped and mounted as shown and there is othing critical about the placement of parts. The b-chassis is fastened to the side of the main chassis two screws in front and by the feed-through cacitors, C_{20} and C_{22} on the rear apron of the main chassis. The AC line filter capacitors, C_{25} and C_{27} are mounted on the bias chassis and project through the main chassis in close-fitting holes.

Ventilation is provided through the panel door and the vent holes over each tube. Natural draft provides sufficient air to prevent overheating of the tubes.

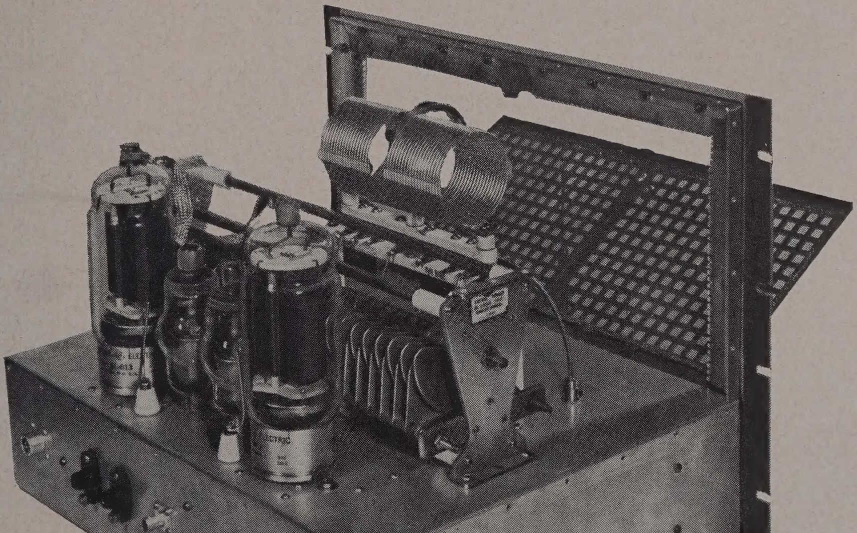
CONSTRUCTIONAL DETAILS

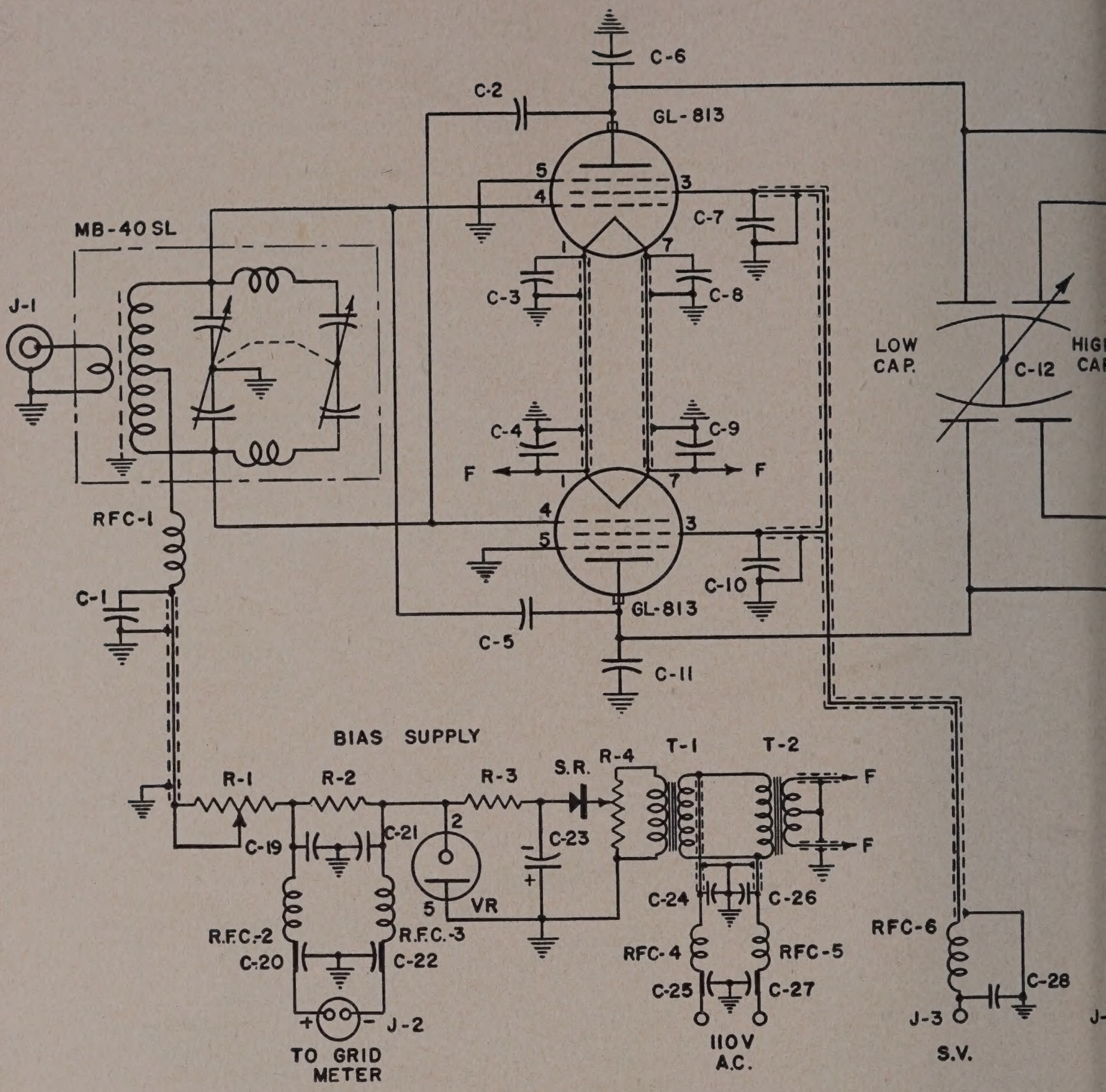
All components are mounted as shown in the photographs on a 13 x 17 x 4-inch aluminum chassis. Aluminum is recommended rather than steel as it is both easier to work and will not rust in damp locations. Even a plated steel chassis will rust around the drilled holes. No special precautions are necessary in the layout that cannot be observed in the illustrations.

The front panel calls for special attention if satisfactory shielding is to be achieved. The panel used is a 12¼-inch Par-Metal Grille Door Panel (Cat. No. G-682). In making the panel RF-tight, the paint was removed by soaking the entire panel in paint remover and then rinsing well. After this was done, the panel was copper-plated. While plating is not absolutely essential it will result in a more permanent shielding job.

After plating, a piece of standard bronze insect screen was carefully soldered to the inside of the grill door.

The next operation was to install the RF weather stripping. The particular material used was made by Instrument Specialties Co., Little Falls, N. J. (Cat. No. 97-112-H). This material is ⅞-inch-wide beryllium copper strip with ⅛-inch wide fingers, 5½ fingers per inch. Similar stripping of other manufacture could also be used satisfactorily. This strip is held to the panel by a ½ x ½-inch aluminum angle running completely around the sides and top of the door opening and secured to the panel with brass machine screws.




C-6
C-2
GL-813
5
4
3
C-7
MB-40 SL
J-1
1
7
C-3
C-8
LOW CAP.
C-12
HIG
CA
C-4
C-9
F
F
1
7
RFC-1
4
3
5
C-10
C-1
GL-813
C-5
C-11
BIAS SUPPLY
R-1
R-2
R-3
S.R.
R-4
T-1
T-2
F
F
C-19
C-21
2
C-23
5
VR
C-24
C-26
R.F.C.-2
R.F.C.-3
C-20
C-22
RFC-4
RFC-5
RFC-6
C-25
C-27
C-28
J-2
TO GRID METER
110V A.C.
J-3
S.V.
J-

C_1, C_3, C_4, C_8, C_9—.002 mfd. disc ceramic (Centralab DD-202)

C_2, C_5—Neutralizing wires (see text)

C_6, C_{11}—12 mmf. vacuum capacitor (GL-1L21 or 1L25)

C_{12}—100 mmf. per section, split stator. (Bud 1633A modified as described in text.)

C_7, C_{10}, C_{28}—.0005 mfd., 1000-volt mica (Sprague 3CFM-35)

C_{13}—.002 mfd., 5 KV (Sprague Hypass 47P16)

C_{14}—500 mmf., 20 KV ceramic (Sprague 20DK-T5)

C_{15}, C_{16}, C_{17}, C_{18}, C_{20}, C_{22}—.001 mfd., 500-volt ceramic feed-thru (Centralab No. FT-1000)

C_{19}, C_{21}, C_{24}, C_{26}—.001 mfd., disc ceramic (Centralab DD-102)

C_{23}—10 mfd., 450 VDC electrolytic (Sprague EL-1)

C_{25}, C_{27}—0.1 mfd., 250 VAC (Sprague Hypass 48P9)

R_1—5000-ohm, 25-watt, adjustable wire-wound

R_2—100-ohm, 2-watt

R_3—10,000-ohm, 5-watt, wire-wound

R_4—25,000-ohm, 25-watt, adjustable, wire-wound

T_1—Thordarson T-22R12, 117/120, 6.3-volt; selenium rectifier power transformer. (6.3-volt winding not used.)

T_2—Thordarson T-21F19, 10-volt, 12-amp. filament transforme

SR—100 ma., 135-volt selenium rectifier (GE-6RS5GH1A)

MB-40SL—National multiband tank unit

L_1—B & W type TVH, 500-watt coils.

L_2—B & W shielded link No. 3282.

J_1—UG—90/U, BNC connector

J_2, J_6—Amphenol 80-PC2F locknut receptacles.

J_3, J_4—Millen 37001 HV connector

J_5—SO-239, UHF connector

S_1—Microswitch (BZ-RQ1)

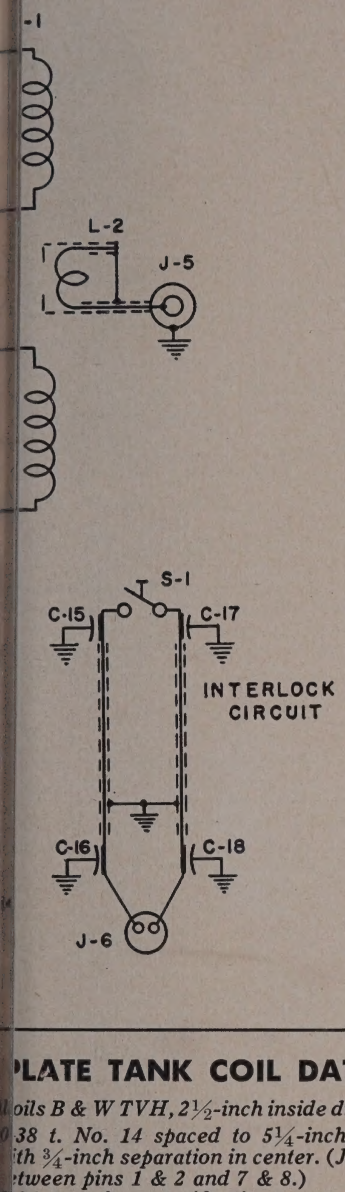
RFC_1—2.5 mh RF choke

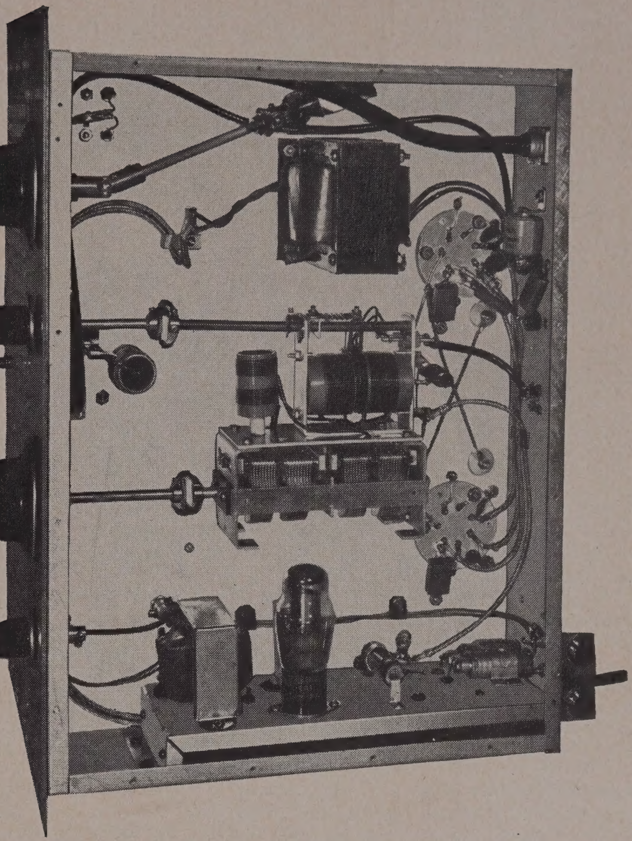
RFC_2, RFC_3, RFC_6—Ohmite Z-50

RFC_4, RFC_5—25 turns, ¼″ diameter, No. 16 en., close wou self-supporting.

RFC_7—4 mh, 750 ma. (Miller No. 4336)

VR—GL-OA3/VR75 voltage regulator tube

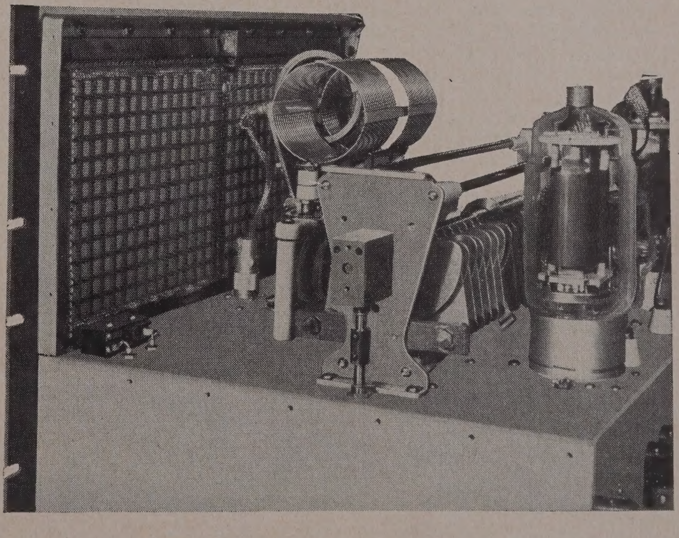




Bottom view clearly shows placement of components. Note RG-8/U output link runs from output connector at top right of picture around upper edge and down to similar connector at left center. Bias supply components mounted on sub-chassis. In close-up picture (below) note RFC$_7$, mounted underneath final tank coil. This view also shows lugs added to tank tuning capacitor when modified as described in text.

LATE TANK COIL DATA

oils B & W TVH, 2½-inch inside diameter
38 t. No. 14 spaced to 5¼-inch length
ith ¾-inch separation in center. (Jumpers
tween pins 1 & 2 and 7 & 8.)
24 t.; other specifications same as 80-
eter coil, including jumpers.
12 t. No. 12 spaced to 4¾-inch length
ith ¾-inch separation in center. (TVH
ith one turn removed from each end.)
8 t. of ⅛-inch d. wire or tubing spaced
6-inch length with ¾-inch separation in
nter. (TVH with one turn removed from
ch end.)
4 t. of ⅛-inch d. wire or tubing spaced
3-inch length with ¾-inch separation
center. (TVH with two turns removed
om each end.)



This angle serves the dual purpose of providing a support for the cover as well as holding down the RF weather strip.

The chassis cover is made of 1/16-inch soft aluminum, bent by clamping it over the edge of a work bench using a piece of angle iron and two "C" clamps. Lips should be bent on the edges of the back to be bolted to the sides after all bending is completed. Self-tapping screws are used to hold things together here. The ventilation holes over the tubes should be drilled before the cover is bent. (Those who notice the photographs show a plate with vent holes bolted over two large holes in the top of the shield are asked to excuse a mistake made during construction. It was intended to drill a fancy design in the top for vent purposes but the drill unfortunately slipped. Again, we recommend simplicity!)

The chassis for the bias supply was conveniently formed over a short length of 2 x 4-inch lumber. This made it exactly the right width and also furnished a back-up block for drilling operations.

Do not skimp on the number of screws used in holding the shielding together. Any gaps in the joints provide a chance for RF to leak out. The bottom plate should be fastened with several self-tapping screws along each edge rather than with the screws in each corner as provided by the manufacturer.

Two ¼-inch diameter holes should be drilled in the back opposite the neutralizing wires for later use in adjusting the neutralization.

After the construction and wiring is complete, the outside of the panel and the cover can be painted with a hard machinery enamel.

After all mechanical details are complete, the amplifier may be wired. Shielded wire was used exclusively—RG-58/U coax for the high voltage leads and ordinary single-conductor shielded wire for the low voltage wiring. The filament leads should be No. 14 shielded wire. Ground the shielding at both ends of the leads and wherever else it may be convenient.

Lead lengths on all by-pass condensers should be kept as short as possible.

The Sprague Hy-Pass capacitor used for C_{13} was considered desirable as it allowed the return to be made to the under side of the chassis, providing a short and direct path to the cathode. If it were made to the top of the chassis, the RF would have to find its way through the chassis in order to complete the circuit to the cathodes and could well result in instability due to incomplete plate by-passing. This capacitor is mounted through a snug-fitting hole and held in place by a small brass angle on the underside of the chassis. This angle also provides the ground connection for the capacitor.

The interlock circuit and grid current meter terminals are protected by an aluminum cover cut from a coil shield can.

MODIFYING THE PLATE CAPACITOR

The modification of the plate tuning capacitor requires some careful workmanship. The capacitor, before modification, consisted of two sections—each with ten stator plates. The seventh stator plate from each end was removed by sawing through the support rods ¼-inch from each side of the plates. Next, four pieces of ½-inch diameter insulating rod (mycalex was used) were cut to fit exactly the gaps left between the sixth to eighth plates. The ends of these insulating spacers were drilled and tapped to take the threads of the stator support rods. No changes were made in the rotor assembly. This left a capacitor having four separate stator sections—the two inside sections consisting of three plates each, and the two outside sections six plates each. Suitable heavy solder lugs, visib
in the photographs, are inserted between both ends
the insulated rod and adjacent plates to allow co
nections to be made to the stators.

The shielded link is plugged into an SO-239 coaxi
connector mounted on top of the chassis, to allow th
link line to feed through the chassis and connect
the output connector on the rear apron. Both co
nectors are shielded where the coaxial jumper connec
by means of standard receptacle hoods designed f
this purpose. The shielded link is supplied with a pa
of shielded leads. To use the link with coaxial ci
cuitry, it is necessary to connect one inner conductor
the shielding braid right at the link, leaving a sing
shielded lead for connection (see circuit diagram).

The bases of the GL-813's are grounded to the chass
by small metal clips from a socket for a GL-4-250
Since these may not be readily available, a suitab
clip can be made from spring brass or bronze.

TUNING UP

The first step in getting the amplifier into operatic
is to set the bias voltage. This can best be done befo
the supply is fastened in place. After checking to be su
all wiring is correct, apply power and adjust R_4 for
current of 5 milliamperes through the VR tube. Th
easiest way to check this is to measure the voltag
drop across the 10,000-ohm series resistor, R_3, using
VTVM or high resistance DC voltmeter. This will
50 volts DC for 5 milliamperes of current. Bias resisto
R_1 should be set at 3500 ohms for a plate supply voltag
of 1600 volts and 3000 ohms for 2000 volts. If onl
CW operation is contemplated, set R_1 at 2500 ohm
The higher values will be satisfactory for both phon
and CW work but it is recommended that slightl
lower grid drive be used on CW, approximately
milliamperes per tube. It is good practice to use th
minimum amount of drive for full output under a
conditions as an aid to keeping down harmonic gener
tion.

Neutralizing should be accomplished as explaine
under "Circuit Details" *only* if fully adjustable pla
and screen voltages are available. Otherwise it shoul
be done in the conventional manner by coupling
sensitive RF indicator to the plate tank and adjustin
the neutralizing wires for minimum output.

It is recommended that all wiring to the pow
supplies and meters be shielded and the shiel
grounded at both ends.

Several methods of obtaining screen voltage a
possible. A series dropping resistor from the pla
supply may be used for phone work only or a volta
divider across the plate suppply could be used for CV
The method used with this final was a fixed supp
of 350 to 400 volts with choke output consisting of
standard 10-henry filter choke. This method allo
the screens to modulate themselves and has the adde
advantage of not requiring any changes for CW wor
When going from phone to CW it is only necessary
turn off the modulator supply and short the seconda
of the modulation transformer.

This amplifier has proved itself in all respects. It
easy to build; provides a good quality signal; an
offers sufficient power to compete with the best.

PARASITICS

In the 220-megacycle converter in the Septembe
October 1954, issue of G-E HAM NEWS (Vol. 9, N
5), coils L_1, L_2, L_4 and L_{10} should be wound on ¼-inc
forms instead of ½-inch forms as described in the par
list. Also, RFC_5 should have 15 turns, instead of 5.

SWEEPING *the* SPECTRUM

Hey, fellows, don't forget the deadline for entering minations in the Third Annual Edison Radio mateur Award is January 3, 1955. Complete rules e on page one of the September and October issues QST and page one of the September issue of CQ. e award means not only acclaim for the winner d recognition for the person responsible for his mination—but also the Award gives ham radio a g boost. Get those nominations in.

* * *

CD workers may be interested in the following ticle by VE4BN in "Sparks," published by the randon (Manitoba) Amateur Radio Club.

"During the last war the enemy had a CD comunications system—one of the most extensive nets ever had the opportunity to monitor. The number of ations on this net was amazing. The area covered was assive—from Channel to Baltic in the north, along e Russian front, south to Italy, along the Mediternean, and all the land between. Guess what band this eration took place on . . . long-wave. Down around 0 kcs.

"The operators were good, the discipline rigid—nd unauthorized transmissions were nil. The activity at took place on this net after an Allied raid on the uhr was feverish in its intensity. All traffic was ded, not high-grade cypher, and not for security's ke—but for speed in transmission. These messages ere requests for medical, fire fighting aid, etc. The ansmitters were VFO, several stations could work t once by going up or down in frequency, and still be ery close to net frequency. This can only be accomlished on long-wave. And guess the mode of operaions . . . CW."

* * *

One letter out of ten—and we get more than a housand here in the course of a year—asks how to hange one of our circuits in order that a slightly ifferent component can be used or so the piece of quipment will do something a little different than hat it was designed for.

These are not easy letters to answer in most cases. e want to help all we can. But, as we have written o countless fellows, it simply is not possible for us to nter into a design or re-design project upon individual equest. Usually, it's not only that the design or reesign calculations take a lot of time (we build each iece of equipment on paper before touching a drill or oldering iron) but, also, it's a matter of responsibility.

We simply can't afford to make some calculations nd then pass this information on to someone else to arry through. For we stand behind every design we ublish; and that means we have built the piece of quipment—often several models of it—and tested t thoroughly. So we know it works the way we say it oes.

Now for us to go back somewhere near the beginning of the job and make some design changes so the equipment will operate a little differently—and still guarantee operation—may not sound like a big project. But sometimes we can't tell how big a project such a change is until we also carry through with perhaps new construction and new conditions and complete a series of tests on the new design. And this, as I said before, we cannot do on individual request. So, in most cases, we are forced to reply by saying simply that we are sorry but the design has been worked out to do that particular job in that particular way, and with those particular components—and in making changes and substitutions you'll be on your own.

* * *

Good dynamic regulation in a power supply (see G-E HAM NEWS, Volume 9, Nos. 1 & 2) is particularly important in an SSB transmitter to obtain the peak output of which the amplifier is capable. And with so many fellows turning to SSB (over a thousand, according to what we hear), the question continually has come up as to just what practical advantage you get with 100 or so microfarads of capacity in your power supply filter. In other words, a lot of fellows ask if 20 or 30 microfarads won't do just as well in practical operation.

The answer lies in the oscillograms of our issue of Volume 9, No. 1. They show the sort of dynamic regulation you get with varying amounts of capacity. They show how performance improves continually as you add capacity. You will note, however, that the performance has improved tremendously by the time the capacitance reaches a value of 45 microfarads. After that, although the improvement continues with additional capacitance, the improvement naturally is smaller.

Now when you get into this latter region—the region where, quantitatively, the improvement is small—the effect on practical operation of your transmitter begins to depend to a larger and larger degree on just how well the rig is working in other respects. In other words, if everything else in the transmitter is otherwise capable of ideal performance, the best dynamic power supply regulation obtainable is necessary to exploit this capability. On the other hand, if the rig's capability is limited, the improvement brought about by the last 50 microfarads or so of filter capacity will not make a great difference in practical on-the-air operation.

What it all boils down to is this, as we said in Volume 9, No. 2: "It is difficult to see how one can get too much capacity built into the power supply." This means, of course, you should put in all the capacity you can get hold of—but don't starve the XYL and Jr. op in the process of buying filter capacitors.

—*Lighthouse Larry*

To Honor Amateur Radio

FOR OUTSTANDING PUBLIC SERVICE

Nominations now are open for the Third Annual Edison Radio Amateur Award—to be granted for outstanding public service by a United States amateur in 1954. The deadline is January 3, 1955.

Any individual or group may nominate a candidate for this Award. Letters of nomination should include all details of the public service performed, and should be mailed to:

Edison Radio Amateur Award Committee
Tube Department
General Electric Company
Schenectady 5, New York

Judging will take place in mid-January and presentation of the Award and prize will follow shortly thereafter. Judges for the 1954 Award are:

Val Peterson, Administrator, FCDA
E. Roland Harriman, President, Red Cross
Edward M. Webster, Commissioner, FCC
Goodwin L. Dosland, President, ARRL

Detailed Award rules are listed on page one of QST magazine for September and October and CQ magazine for September. A copy of these rules will be mailed to anyone upon request.

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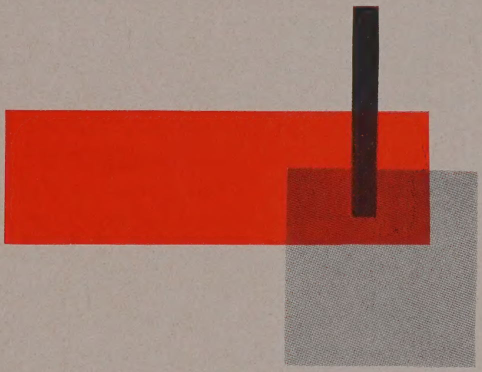
JANUARY–FEBRUARY, 1955

VOL. 10–NO. 1

announcing
"OPERATION CRYSTAL"
a challenge to all radio amateurs



Your solution to this problem will prepare your family and your community for emergencies

OLD-TIMER AND NOVICE ALIKE CAN MAKE A VALUABLE CONTRIBUTION TO THE PUBLIC WELFARE IN "OPERATION CRYSTAL"

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OPERATION CRYSTAL

it can happen here . . .

Disaster . . . no radio, no newspaper, no telephone . . . Hurricane? Explosion? A-bomb? H-bomb? How many bombs? What should you do to save yourself and your family?

Your car radio soon goes dead after you run out of gas . . . but the disaster goes on, gets worse . . . two days, three days . . . no trains, no trucks, no food . . . you recall how easy it was to get information with radio, newspaper and telephone. . .

The third day your neighbor's portable radio goes dead . . . the storekeeper laughs when you mention batteries . . . you remember how fresh milk used to taste . . . and you say you'll never eat cold canned food again, if you get out of this . . .

IF you get out . . . but you can't get out without information! Is help on the way? Or are worse disaster areas taking up all the relief? Should you start hiking? Which way? North? South? East? West? Will there be more bombs? More hurricanes? Where will they hit? And when?

Still no radio, no newspapers, no telephone . . . just rumors—wild, contradictory rumors that may lead you the wrong way . . . one neighbor says flee . . . another says stay.

Superhuman effort has kept one broadcasting station on the air, perhaps on the Conelrad frequency. But you can't hear the official reports and advice without power or batteries.

What is the answer? You, the radio amateur have the answer—right in your junk box. You guessed it. A crystal diode detector.

There are probably as many ways to hook up a powerless diode detector in an emergency as there are amateurs. What works best on the broadcast band in your locality?

G-E HAM NEWS will award $10 tube certificates for the three most outstanding emergency crystal diode designs submitted for publication for each issue during 1955. In addition, we will award copies of our first Bound Volume (plus a complete set of subsequent issues) and one-year subscriptions to G-E HAM NEWS for other designs accepted for publication. Be sure to include in your contribution some notes on local receiving conditions. DO NOT SEND IN YOUR MODEL. All material submitted becomes the property of G-E HAM NEWS.

During a recent hurricane, our editor was visiting in New Jersey. Although the storm merely jostled the community, 25,000 homes were without power for the entire week-end.

Fretting because he couldn't turn on the BC set to learn about progress of the storm, it occurred to W2ZBY that every home ought to be equipped with a crystal detector for emergency purposes—and, furthermore, that the neighborhood ham is the logical person to show folks how to provide themselves with such an affair.

Impressed with the endless variety of crystal set designs possible with modern components, we decided to ask you fellows to help. Receiving conditions vary almost from house to house—depending on signal strength of local broadcasting stations, available space for antennas, the character of grounds, and so on ad infinitum.

Here is a discussion of some of the basic principles and how they have been turned into practical circuits by a few of the G-E hams. Old timers' experience should enable them to make significant contributions to this emergency and civil defense need. But that's not to say novices can't do just as well or better. And, incidentally, what better way is there for a novice to get some basic practical experience with tuned circuits?

Let's have your contributions, fellows.

—Lighthouse Larry

The basic component in a simple radio detector is a ctifier to peel the audio envelope from the incoming F signal. In the early days of crystal sets a small unk of the mineral galena was found to be a pretty ot" rectifier. The rectified signal was taken off the ece of galena with a very fine wire called the "cat hisker."

The big trick was to find a good "sensitive" spot the galena. This inconvenience is eliminated today germanium diodes which now are turned out like ttons. Thus the germanium diode—often called a ystal diode—looks like a good bet for simple diode tector design.

However, it might be worth mentioning at the outset at a poor connection caused by rust or corrosion of me other kind can serve the same rectifying purpose. he rust or corrosion creates a "semi-conductor"— ssing RF current in one direction.

Every once in a while one finds an audio-resonant stem attached to the corroded metal—like, for in- ance, a bathtub of proper dimensions with rusty pes—and lo and behold, we actually have a "singing thtub." This phenomenon is, of course, the basis r the oft-told tales in ham circles about the old lady xt door complaining she can hear your voice CQ'ing the gold in her teeth or booming out of the drain pipe her sink.

A fellow located close enough to a high power broad- ast station often can pick up the local program by utting on a pair of headphones and touching the pin ps to his water pipes, a window screen or his bed rings.

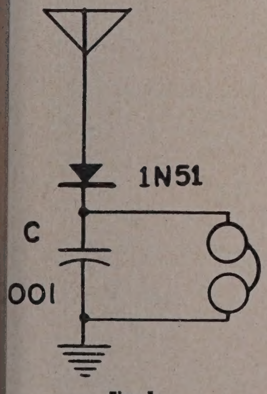


Fig. 1

A slightly more complicated—but very un-electronic—type of rectifier can be made with a pair of razor blades, a bar of soap and a needle. Another version—reported from Alaska—is a "blue blade" and a safety-pin used as a "cat whisker."

However, for more reliable performance, we suggest the crystal diode. And this can be hooked up in a variety of ways. Perhaps the simplest—again usable only in strong signal areas—is illustrated in Figure 1.

Here a piece of wire for an antenna is connected to one side of the diode, the other side of the diode to the earphones—which are by-passed by C—and the other side of the earphones to ground. The efficiency of antenna and ground required will vary with local conditions—depending principally on the strength of the incoming signal.

However, when you get farther away from the broadcast transmitter, you find the need for more over-all efficiency than the best ground and antenna alone can give. Thus the next step is to employ a tuned circuit, as in Figure 2. In this circuit, L and C are tuned to the frequency of the station desired—and it still must be a pretty strong station with this simple setup.

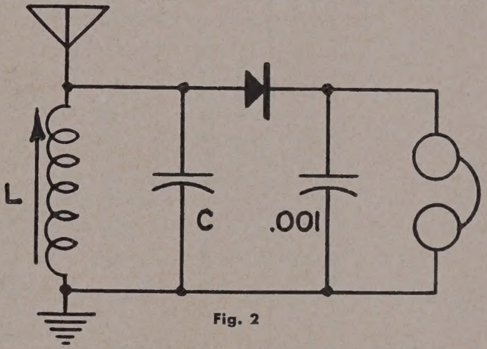


Fig. 2

From this point on the experimenter can branch out into countless forms of antennas, grounds, and tuned circuits.

For instance, Don Norgaard, W2KUJ—designer of the Signal Slicer, the SSB Jr. and other pieces of somewhat more complicated gear that have been described in past issues of G-E HAM NEWS—recalls considerable success many years ago with an arrangement like that shown in Figure 3.

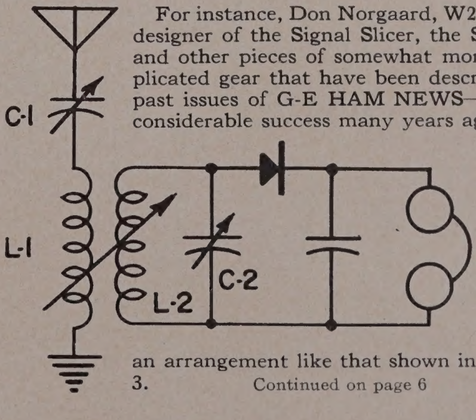
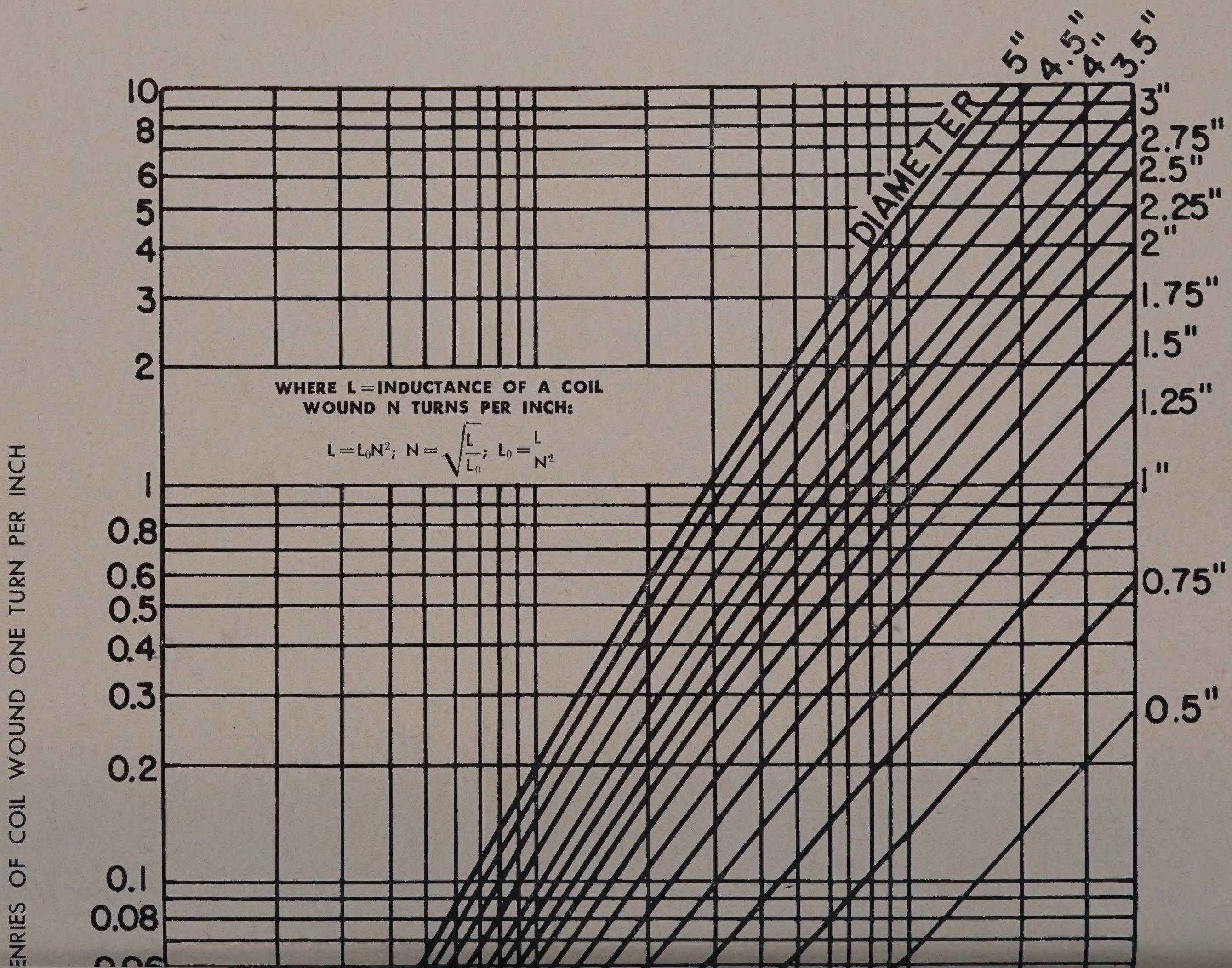


Fig. 3

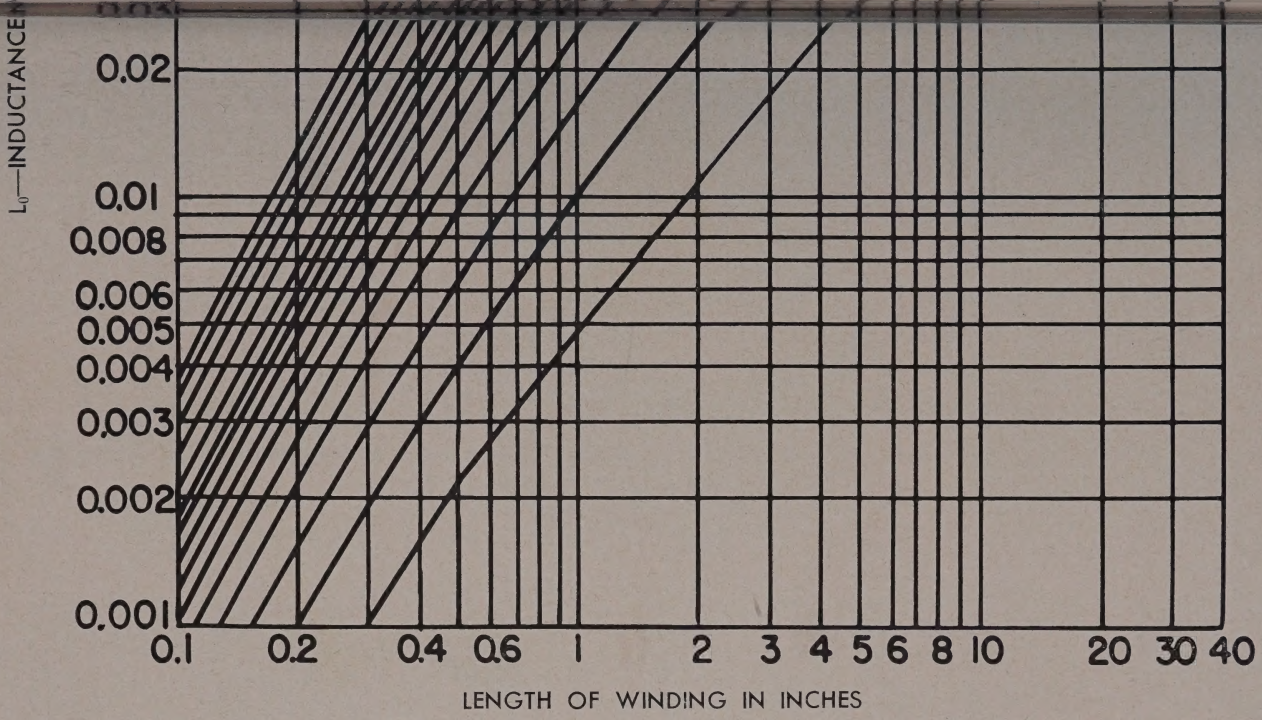
Continued on page 6

COIL INDUCTANCE CALCULATOR



WHERE L = INDUCTANCE OF A COIL WOUND N TURNS PER INCH:

$L = L_0N^2$; $N = \sqrt{\frac{L}{L_0}}$; $L_0 = \frac{L}{N^2}$



The accompanying chart shows inductance of coils wound one-turn-per-inch. To find the inductance of a multiturn coil of the same dimensions, use

$$L = L_0 N^2$$

where L is the unknown inductance and N is the turns-per-inch of the coil in question. (Note—N is *not* the total number of turns on the coil!)

Example: You have a 60-turn coil 3 inches long and 1.5 inches in diameter and wish to know the inductance. The turns-per-inch, N, is 20; and from the chart you determine L_0 is 0.14. Substituting in the above,

$$L = 0.14 \times 20^2 = 0.14 \times 400 = 56\ \mu h$$

Similarly, to find the number of turns necessary to arrive at a desired inductance with a coil of specified length and diameter, use

$$N = \sqrt{\frac{L}{L_0}}$$

Example: You have a 1-inch diameter coil form with space for a winding 2 inches long and want to know how many turns are required to obtain an inductance of 30 microhenries. From the chart, L_0 is 0.04. Substituting in the above formula,

$$N = \sqrt{\frac{30}{.04}} = \sqrt{750} = 27.01 \text{ turns-per-inch}$$

Total turns for a 2-inch coil, then, will be 54.

In addition, the formula

$$L_0 = \frac{L}{N^2}$$

can be used to determine either length or diameter, or both, when using a ribbed coil with a fixed number of turns-per-inch.

Example: You have a ribbed form 2.5 inches in diameter which calls for 7 turns-per-inch, and you want to wind a coil with 10 microhenries inductance. Substituting in the above formula,

$$L_0 = \frac{10}{7^2} = \frac{10}{49} = 0.2.$$

On the chart follow the 0.2 horizontal axis out to where it intersects the 2.5-inch diameter curve. From this point, drop down the vertical axis and read the length of winding required—in this case, 2 inches. (This same procedure can be used when double- or triple-spacing a winding on a ribbed form. In the case in point, double-spacing would dictate use of 3.5 for N, and triple-spacing 1.75 for N.)

This simple crystal set was built and used in Texas—and it brought in KDKA from Pittsburgh, KFI from Los Angeles, and many stations in between. Let's take a closer look at it.

In the first place, the antenna was about 180 feet long. It was No. 30 wire—to conceal from the rooming-house landlord the fact that a radio was in the house.

Note, also, that two tuned circuits plus the coupling between them afforded a total of three tuning controls. Not quite as simple an affair to tune as today's BC set with its one tuning knob—but much more effective. Both the series-tuned circuit of L_1 and C_1 and the parallel-tuned circuit of L_2 and C_2 must be tuned to the desired frequency, and the coupling between the coils must be correct. Varying this coupling can change the tuning of the resonant circuits, of course, and this is what complicates matters a bit in tuning such an arrangement.

To return, for a moment, to the subjects of grounds and antennas. The average home contains quite a few possibilities. Another G-E ham—Bill Coffey, W2ZHI—found a few loops of wire strung around a window frame pretty effective. Another OM here—who in this instance prefers to remain unnamed—suggested that as long as the telephones weren't working and it was a real tough emergency the telephone line would make a nice antenna. He also commented that your body—floating with RF of indeterminate phase—often does quite well as a sky-hook.

Another G-E ham found the best ground at his house is the kitchen sink drain pipe. The sink empties into a dry-well through a forty-foot 2-inch pipe buried about two feet underground. For some reason this pipe surpasses the well, the water pipes and the drain to the septic tank.

HOW ABOUT COMPONENTS?

Figure 4 shows a fairly efficient little BC receiver made by W2ZBY with the relatively new "loopstick" type antenna. (The circuit is the same as Figure 2.) The broadcast band can be tuned by sliding the ferrite slug in and out. Although the slug in this particular loopstick is designed to be cemented permanently in place, a simple method of arranging for tuning is to cement a matchstick into the hollow core of the slug, then cement a soft rubber washer into the top end of the loopstick coil form to act as friction-type holder for the matchstick. The coil is tuned with a 330 micro-microfarad ceramic capacitor. A mica trimmer could be used to band-set the receiver with a variety of antennas.

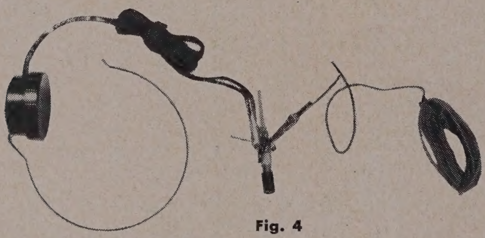


Fig. 4

The phone tips are held by clips pulled from an old tube socket. One clip is soldered to one of the loopstick terminals; the other is forced in between the loopstick coil form and a paper-insulation ring that comes on the loopstick. The single earphone illustrated is an inexpensive (96¢) 1000-ohm affair purchased from Allied Radio in Chicago. The entire receiver can be housed in the cardboard box the loopstick comes in, a plastic pill box or any other convenient nonmetallic container.

A deluxe arrangement—worked out by W2GYV—is shown in Figure 5. This employs the common coil and capacitor found in old broadcast receivers. Only on section of the capacitor is used to tune the broadcas band. The circuit is shown in Figure 6. The 50-micr microfarad capacitor provides additional coupling Other arrangements may work better in other loca tions.

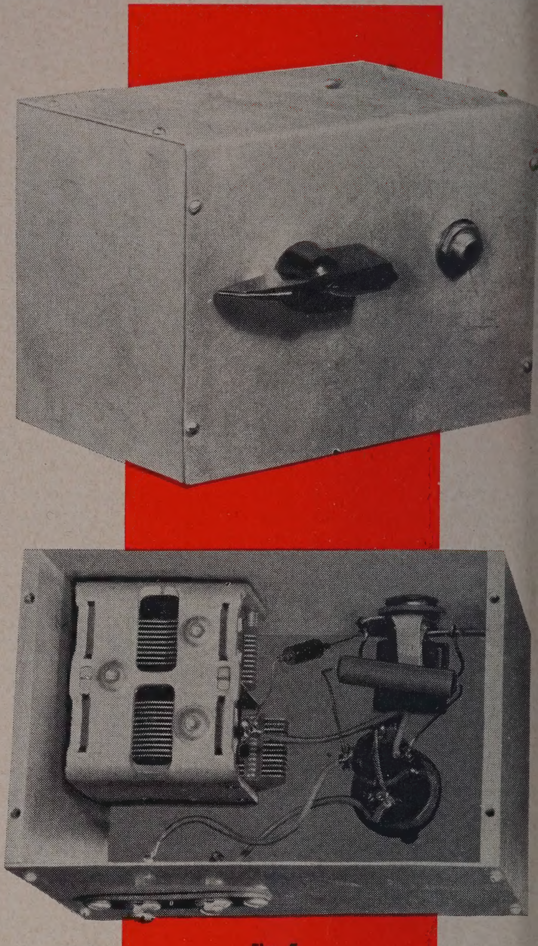


Fig. 5

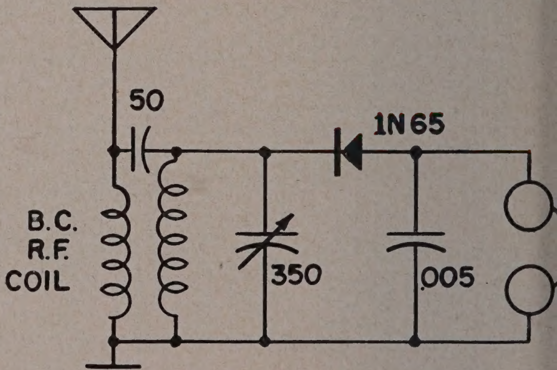
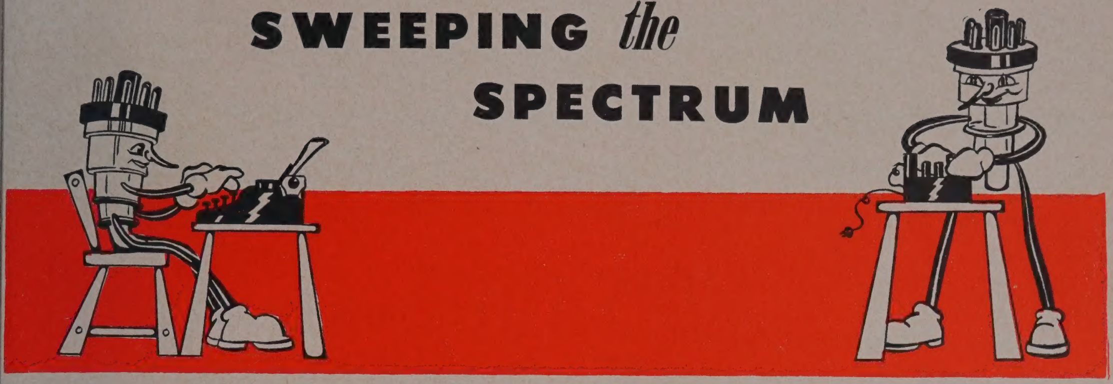


Fig. 6

We've thought of installing a diode detector in a empty "can" on one side of a head set, in a hat, an in an empty wristwatch case—comic strip style.

Any more ideas?

SWEEPING *the* SPECTRUM



It never fails to happen! Just when you want every-ing working in apple-pie order, things start going aywire. Our editor reports this one. He recently anned to entertain VE3BV at his shack. Earlier that ay he threw the switches on his SSB rig—and nothing! o output from his Model 10A exciter. After a lot of air-tearing, poking, and so on he gave up and hauled e exciter over to W2KUJ's lab.

W2KUJ turned the rig on and lo and behold it worked e. They went through it with a fine-tooth comb and und nothing wrong. Back to W2ZBY again, and it ill worked fine. The only explanation any of us have een able to offer is that bouncing it over the rocky ad from Scotia to the G.E. Research Laboratory ook out a gremlin or two.

However, the real hooker is that 75 turned out to e so stinko that night the boys considered themselves cky to make the one QSO they did—WϕGK in Kansas.

We'll admit that with all the precision test equip-ent available in these parts, one of our own mainte-ance procedures—after checking power lines, tubes nd connections—is a healthy wallop with a baseball at. This dislodges dust, solder particles, loose nuts nd often fixes intermittent shorts and open connec-ons. But, alas, the cure is not permanent.

One of our G-E hams—W2YIV—had a hand in eveloping Alkanex, the new wire insulation you may ave heard about. Alkanex can be used safely at much igher temperatures than even G.E.'s famous Formex.*

In experiments, Alkanex has been baked for six onths at 300 degrees F with no signs of deterioration r loss of insulating strength.

The pulling, bending and flexing of wire during con-truction of transformers and motors and winding coils uts a severe strain on the insulating enamel. And as ou know, proper operation demands that the insula-ion not be broken. In experiments with Alkanex namel, the coated wire has been pounded flat without reaking the insulating film.

⁂ ⁂ ⁂

The lines which not so long ago sharply separated he SSB ops from the AM lads are getting pretty lurred these days. Our mail and reports on the sales of commercially-made SSB equipment tell us that SSB now is considered a "normal" means of communication by the ham fraternity generally. Our editor confirms this, too, because he operates SSB and tells me the phrase "I just got on SSB" is cropping up pretty regularly in the round tables.

The editor also reports that the boys are using about every tube in the book for linear amplifiers. That reminds us that until a very short time ago we were continually flooded with requests for linear operating data on various tubes. These requests have dwindled to a mere trickle. And that, we feel, is a healthy sign. In true amateur spirit, the boys are trying all kinds of tricks with all kinds of tubes.

Time was when our Power Peaker and Lazy Linear were standards (and we still think the 811A is hard to beat for watts-per-dollar!) In fact, not long ago we at G.E. constituted a pretty large percentage of amateur SSB operations. Now, with the influx of hundreds more SSB stations—thousands for all I know—we at G.E. take pride in the fact that although we have been relegated to a pretty tiny percentage of the SSB world, our early articles in G-E HAM NEWS helped make SSB practical for the average ham.

We still expect to run articles on SSB equipment. But we are quite frank to admit that a greater amount of valuable work is being done by the individual hams themselves. In short, we succumb to sheer force of numbers.

Here at G.E. we say "Progress is our most important product." And we are humbly appreciative of the fact that we have had the opportunity to promote amateur progress by pioneering in SSB.

⁂ ⁂ ⁂

The Rochester, N.Y., Amateur Radio Association has set up "Operation Aid"—a ten-man committee dedicated to helping the disabled, sick or hospitalized hams get on the air. They service any ham—RARA member or not—reports the club bulletin, RARA Rag.

⁂ ⁂ ⁂

RARA Rag also say: "One hand in pockey, no get shockey."

—Lighthouse Larry

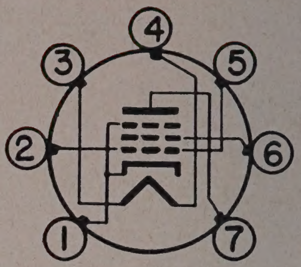
---

*See G-E HAM NEWS, Vol. 8–No. 5.

Technical Information

6CA5

A new G-E beam pentode miniature of possible interest to amateurs in 110-volt plate voltage applications is the 6CA5. Designed primarily for use in audio-frequency power output stages, the tube features high power sensitivity at relatively low plate and screen voltages. Maximum plate dissipation is 5 watts.



GENERAL

Heater Voltage, AC or DC	6.3 Volts
Heater Current	1.2 Amp
Direct Interelectrode Capacitances (approx.)	
Grid 1 to Plate	0.5 $\mu\mu$f
Input	15 $\mu\mu$f
Output	9 $\mu\mu$f

MAXIMUM RATINGS—DESIGN CENTER VALUES

Plate Voltage	130 Volts
Screen Voltage	130 Volts
Positive DC Grid 1 Voltage	0 Volts
Plate Dissipation	5.0 Watts
Screen Dissipation	1.4 Watts
Heater-Cathode Voltage	
Heater Positive with Respect to Cathode	
DC Component	100 Volts
Total DC and Peak	200 Volts
Heater Negative with Respect to Cathode	
Total DC and Peak	200 Volts
Grid 1 Circuit Resistance	
With Fixed Bias	0.1 Meg
With Cathode Bias	0.5 Meg
Bulb Temperature at Hottest Point	180 C

TYPICAL OPERATION—CLASS A_1

Plate Voltage	110	125 Volts
Screen Voltage	110	125 Volts
Grid 1 Voltage	−4.0	−4.5 Volts
Peak AF Grid 1 Voltage	4.0	4.5 Volts
Plate Resistance (approx.)	16000	15000 Ohms
Transconductance	8100	9200 μmhos
Zero-Signal Plate Current	32	37 ma
Max.-Signal Plate Current (approx.)	31	36 ma
Zero-Signal Screen Current	3.5	4.0 ma
Max.-Signal Screen Current (approx.)	7.5	11 ma
Load Resistance	3500	4500 Ohms
Total Harmonic Distortion (approx.)	5	6 Percen
Max.—Signal Power Output	1.1	1.5 Watts

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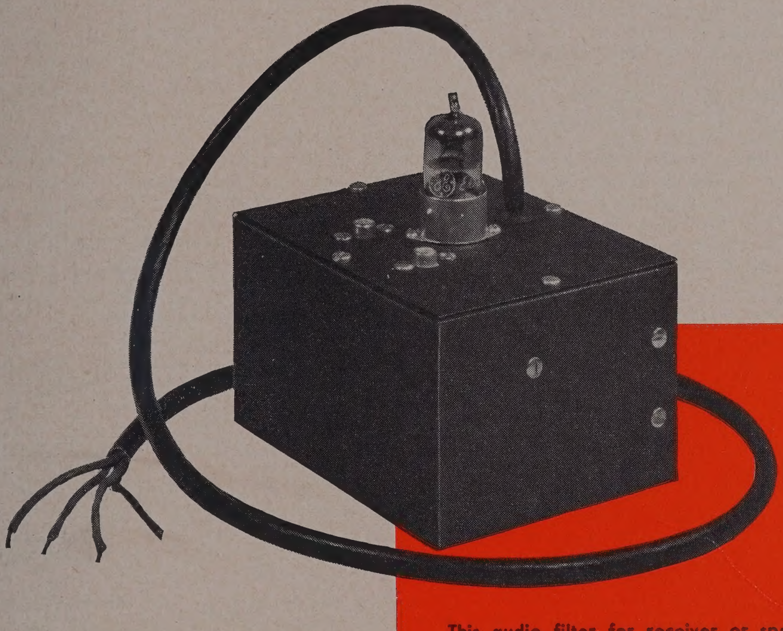
MARCH-APRIL, 1955 VOL. 10–NO. 2

HIGH ATTENUATION LOW-PASS AUDIO FILTER



This audio filter for receiver or speech amplifier uses inexpensive unshielded coils plus a few of W2KUJ's slick tricks to obtain an attenuation slope approaching that possible with high-priced toroid coils.

—*Lighthouse Larry*

**INTRODUCING
A NEW COLUMNIST
FOR "OPERATION CRYSTAL"**

CONTENTS

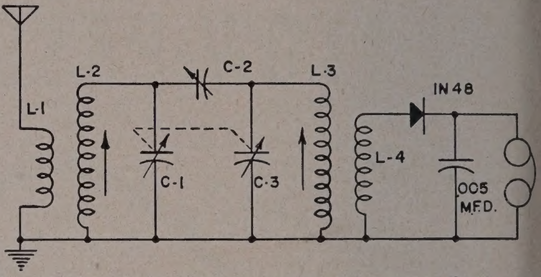
"Operation Crystal"....................page 2
Low-pass Audio Filter....................page 3
Thumbnail Theory....................page 6
Sweeping the Spectrum....................page 7

OPERATION CRYSTAL

The ideas for OPERATION CRYSTAL (see G-E HAM NEWS, Volume 10, No. 1) have been rolling in so fast that Lighthouse Larr has had to add the character you see in the above heading to his staff. Gentlemen: Meet "DANNY DIODE," now in charge of thi department. He has had a tough time choosing the three ideas and circuits published below which qualify for the certificates for $1 in G-E Electronic Tubes. All ideas submitted before December 1, 1955, will be considered for publication in the next five issues of G- HAM NEWS. Send your idea in to Danny Diode today!!

—*Lighthouse Larr*

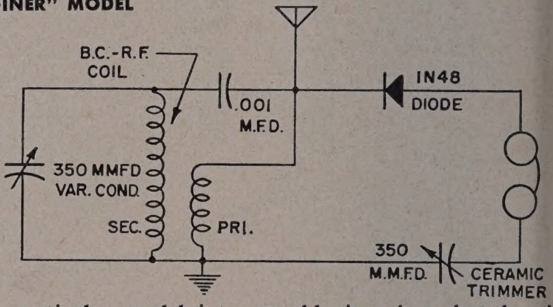
"KNOB TWISTER'S SPECIAL"



This circuit well deserves the above title for it has five tuning adjustments, two of which are ganged for convenience! William Patzer, W8RWX, Benton Harbor, Michigan, says that the 1000-watt local broadcast station was received with enough volume to drive a 4-inch speaker in a quiet room. The selectivity is adequate to separate all the Chicago stations, about 70 miles away, with good earphone volume.

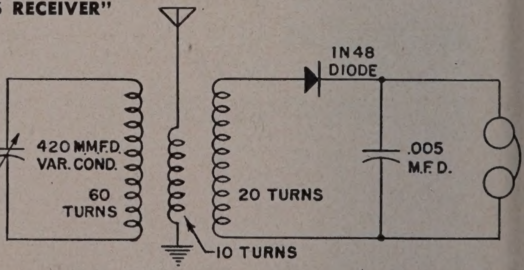
The diagram shows the vari-loopstick coils L_2 and L_3, coupled to L_1 and L_4. These are 30 turns of No. 26 DSC wire wound on a close-fitting cardboard sleeve placed over the winding on the loopstick. The sleeve may be held in place with scotch tape or model-airplane cement after positioning for maximum gain. C_1 and C_3 is a dual 365-mmf variable condenser salvaged from an old broadcast receiver. C_2 is a 0.005-mfd ceramic condenser, and the diode is a 1N48 or 1N52. Some adjustment in the L/C ratio in the tuned circuits can be obtained by adjusting the tuning slugs in the loopsticks for maximum volume as well as for prope tracking of the tuned circuits when several stations are to be received. The coupling condenser, C_2, is a 3–30-mmf compression type trimmer. It is adjuste for maximum volume on local stations or maximur selectivity on distant stations. Imagine a crystal re- ceiver with a selectivity control!!

"FURSCHLUGGINER" MODEL



This tricky little circuit was submitted by Curt Olofsson, W6GTY, who claims it was designed by a Dr. Smerdschlossenzwiehammerschtenkel. A measure of impedance matching is provided by the 350-mmf ceramic trimmer condenser in series with the 1N48 crystal diode. Curt says this really brings up the signal strength when the set is used with a short antenna (25 to 30 feet). The salvaged broadcast receiver antenna coil shown in the diagram is connected "backwards," with the primary winding in the crystal detector circuit. Modern slug-tuned coils are also suitable, such as the Meissner 14-1026 or 14-1056; or a Miller 6300 or 70-A. W6GTY also recommends that medium impedance earphones (about 2000 ohms) be used in preference to high-impedance types (20,000 ohms). He built this particular model into an old cigar box, but hasn' pulled in Havana yet!!!

"DRINKING GLASS RECEIVER"



A clever arrangement built around a 2-inch-diameter plastic drinking glass was master-minded by Jack Lambuth, an eighth-grade school student who unfortunately did not include his street address with his entry. (Please send it to Lighthouse Larry when you read this so I can send you the award certificate for your $10.00 in G-E Electronic Tubes.) He states that WBAA, Purdue, and WASK, Lafayette, Indiana, are received very well using a 25-foot antenna and his bedspring for a ground! This set is another cigar-box construction job.

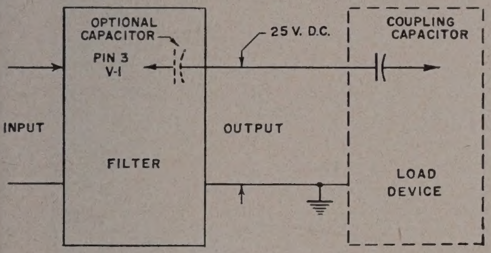
The 60-turn close-wound coil of No. 26 DSC wire on the 2-inch form figures out to approximately 140 uh and tunes with a standard single-gang 420-mmf variable condenser. The 10-turn antenna and 20-turn detector coils are wound over the 60-turn coil with a layer of plastic electrician's or scotch tape for insula- tion. The selectivity of this circuit is also fairly goo because the 1N48 crystal diode does not load th tuned circuit heavily.

LOW-PASS AUDIO FILTER

A sharp cut-off low-pass filter is a great help in minating the annoyance of heterodynes and noise be- nd the range necessary for completely satisfactory hone reception. The filter described here is an in- pensive and highly effective weapon in the fight ainst QRM. Used in the speech system of a trans- tter, this filter reduces the spectrum space occupied the signal, while actually increasing the effectiveness the transmission. It is connected as shown in Fig. 1.

Because the filter is intended for a variety of applica- ns, a vacuum tube is employed to provide high in- t and low output impedance. Thus, all the require- ents of impedance matching for the passive elements the filter are satisfied internally and are not dis- rbed when the filter is interposed between a wide riety of devices.

The design cut-off frequency of the filter pictured on e cover of this issue of G-E HAM NEWS is 3000 PS, a figure generally considered adequate for voice mmunication. Design data is given for the proto- pe low-pass filter in "Thumbnail Theory" for those ho want to design their filter for a different cut-off equency. It is suggested that the 3000 CPS cut-off sign be used unless it is certain that a different cut- point is required for some specific application.



g. 1 Diagram for connecting the low-pass filter to the ut and load devices.

CONSTRUCTION

The entire filter is housed in a 3 x 4 x 5-inch utility x drilled as shown in Fig. 2. The tube socket, input d output jacks are mounted on one cover. Although the filter elements are not in "cramped" space, a certain amount of clearance is required between coils in different filter sections. The circuit diagram and parts list are shown on page 5.

The six 125-mh coils are mounted on the aluminum brackets shown in Fig. 3 with 6–32 brass machine screws 1 inch long which pass through the centers of the coils. The brackets are then fastened to the 3 x 4-inch ends of the box, as pictured in Fig. 4. Note how L_1 and L_6 are mounted with respect to the other coils. All the wiring between the coils, condensers C_1, C_2, C_3 and the 2400-ohm terminating resistor is done with the covers removed. Attach 4-inch leads to the input end of L_1 and the output end of L_6 for later connection to the tube socket.

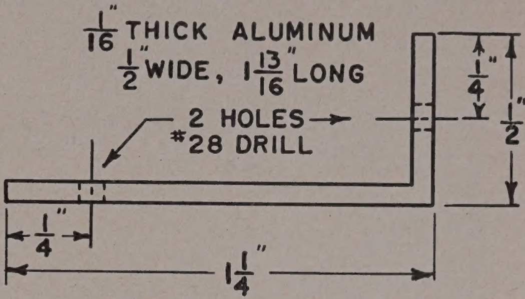


Fig. 3 Mounting brackets for the coils.

The brackets holding L_1 and L_6 should not be securely tightened until after performance tests are completed. Do not rely on the steel box to provide the ground path indicated in the circuit diagram. Instead, run a lead to the grounded ends of C_1, C_2 and R_4, and bring this lead out to the ground points on the top cover. Heater and plate power are supplied through a four-conductor cable anchored to the cover.

TESTS

After a wiring check, heater and plate voltage can be applied. Approximately 25 volts DC should appear across the output resistor. If the correct values of inductors and capacitors have been used, the performance

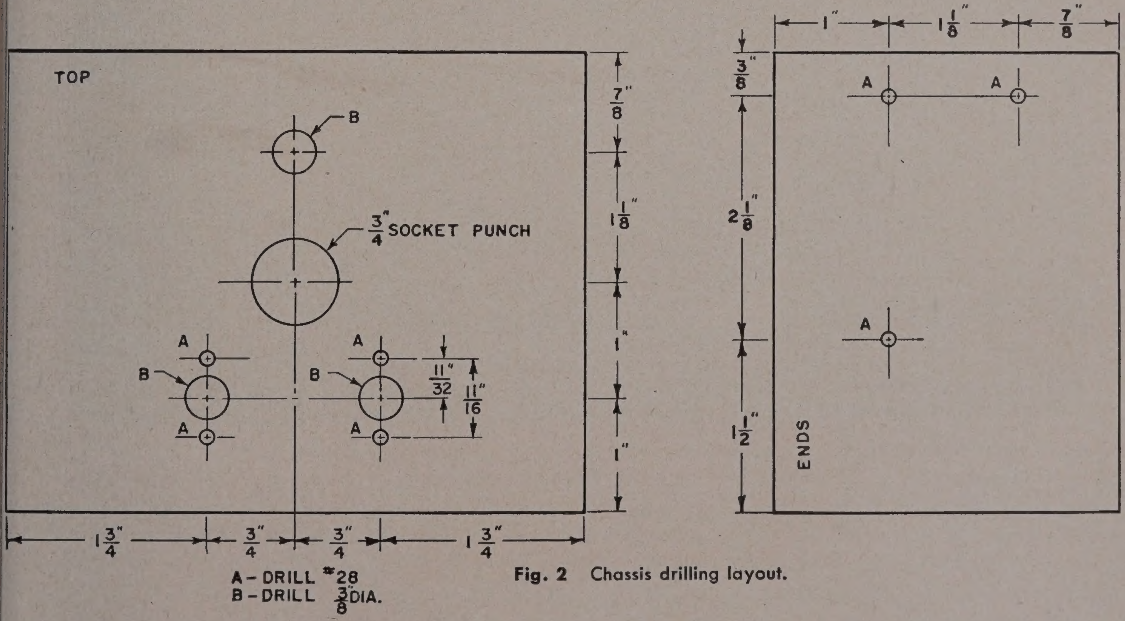


Fig. 2 Chassis drilling layout.

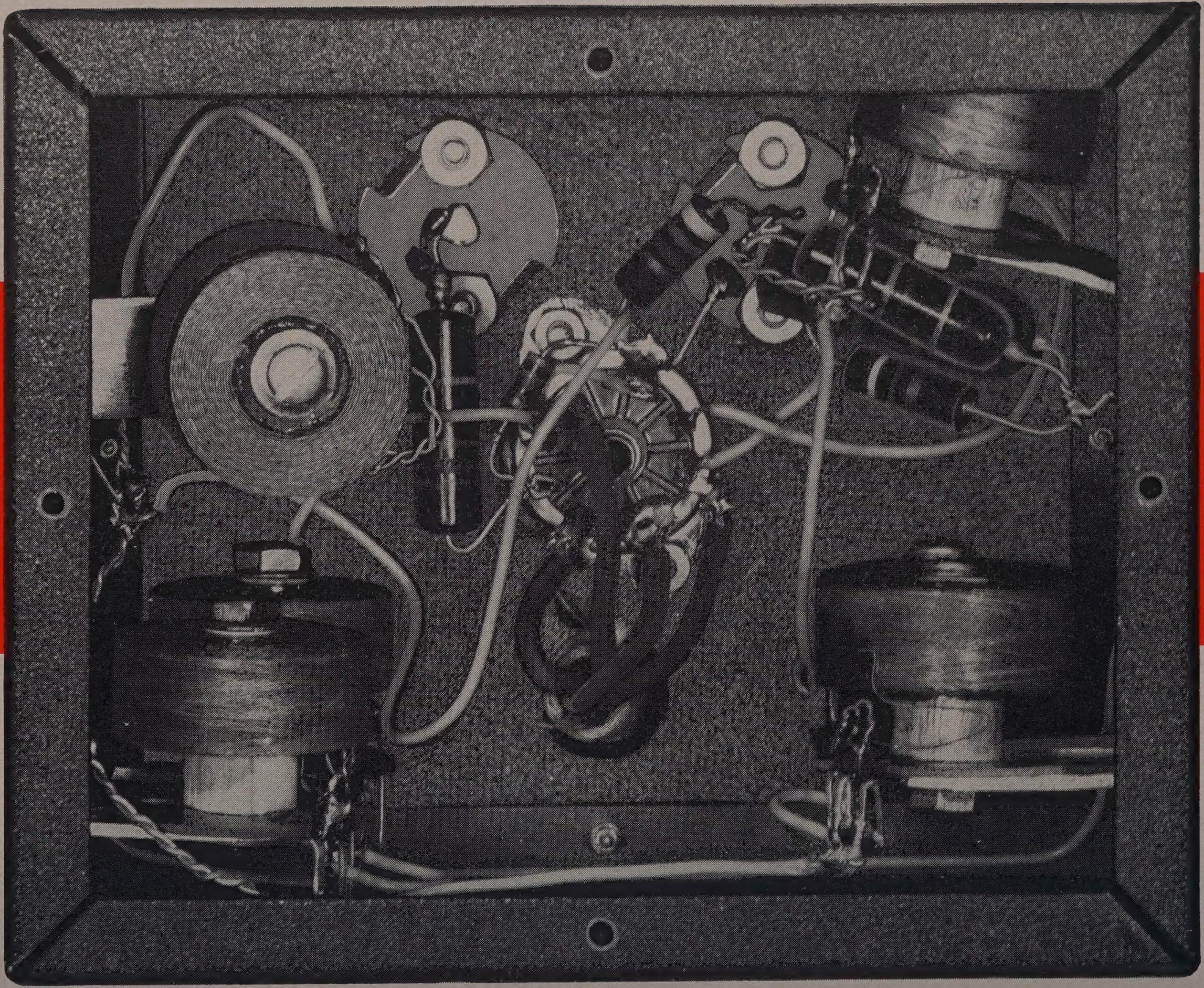
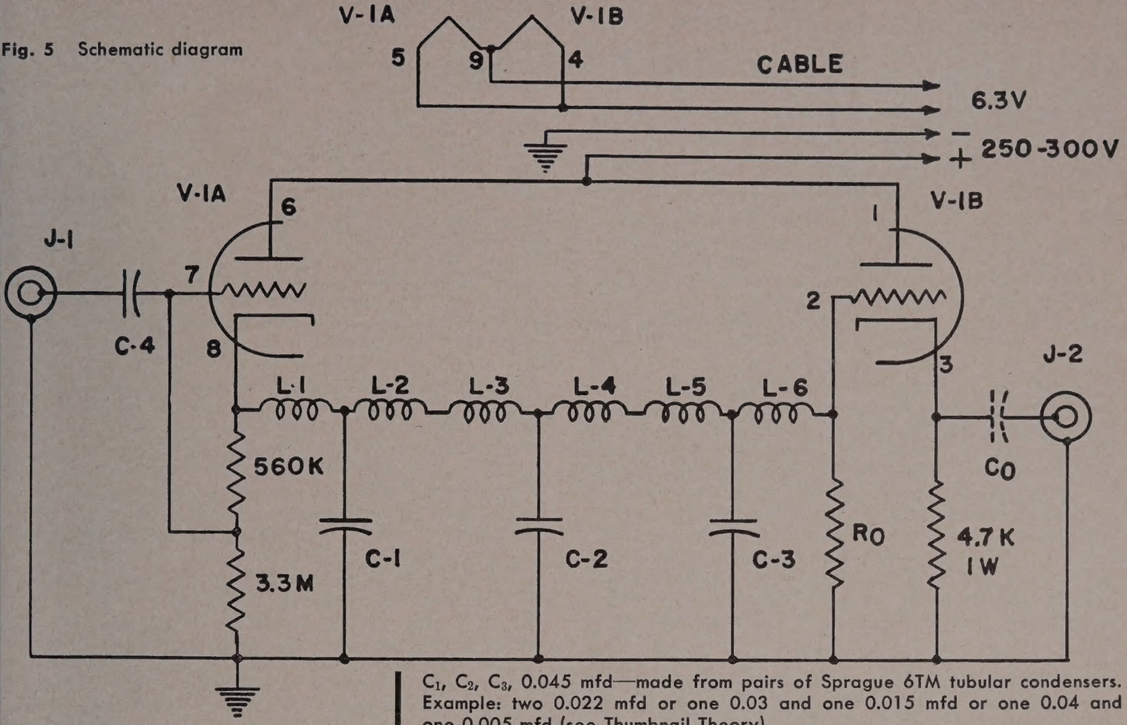


Fig. 4 Bottom view of filter showing socket placed with pins 1 and 9 toward phono jacks. Solder lugs under coil bracket mounting screws are used as ground tie-points for C_1, C_2 and C_3.

Fig. 5 Schematic diagram


V-1A
V-1B
5
9
4
CABLE
6.3V
−
+ 250-300V
V-1A
6
J-1
7
C-4
8
L-1
L-2
L-3
L-4
L-5
L-6
560K
3.3M
C-1
C-2
C-3
V-1B
1
2
3
J-2
Co
Ro
4.7K
1W

PARTS LIST

C_1, C_2, C_3, 0.045 mfd—made from pairs of Sprague 6TM tubular condensers. Example: two 0.022 mfd or one 0.03 and one 0.015 mfd or one 0.04 and one 0.005 mfd (see Thumbnail Theory).
C_4—0.01 mfd, 600 volts.
C_0—Capacity dependent on load impedance, see text (Application).
J_1, J_2,—Cinch shielded phono jacks.
L_1,—L_6—125 mh RF chokes (Meissner 19-6848).
R_0—2400 ohms, 1 watt ±5%.
V_1—12AT7 tube.
All resistance values in ohms, ½ watt ±20% except as noted. K=1000.

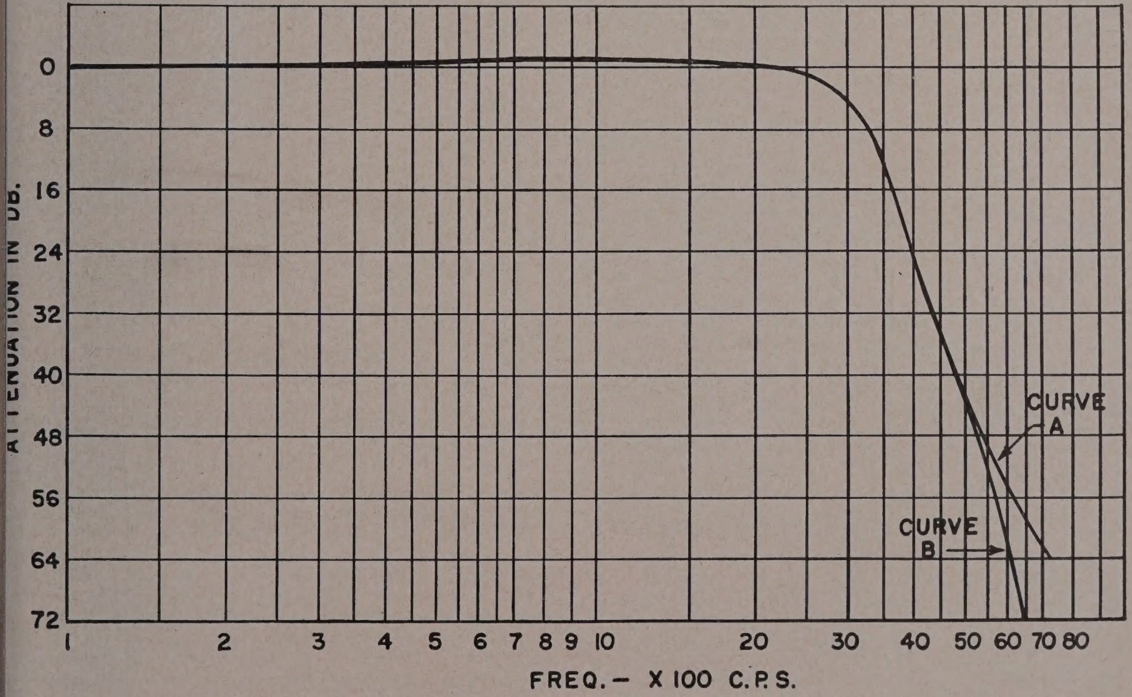


Fig. 6 Response curves with and without coils oriented.

will be that shown by the curve "A" of Fig. 6, at least to an attenuation of 30 db without any further work on your part. Usually an improvement in attenuation at frequencies higher than 4000 CPS can be made by orientation of L_1 and L_6, if suitable measuring equipment is available. Tests made by ear alone are not sufficiently reliable to warrant the effort. A reliably calibrated audio oscillator covering a range from 100 to 10,000 CPS at an output voltage of about 10 volts RMS, and an output indicator covering a range of at least 60 db (1000 to 1 in voltage) are required.

In case orientation of L_1 and L_6 through a few degrees does not allow an attenuation of 60 db or more to be obtained at 6000 CPS, reversal of connections to either L_1 or L_6 (but not both) should allow the performance shown in curve "B" to be equalled or surpassed in the region of high attenuation. The final adjustment of the filter model shown in the illustrations was obtained by setting the test frequency at 7000 CPS and bending the brackets holding L_1 and L_6 for minimum output. Tests with an oscilloscope revealed that the minimum was really a null at 7000 CPS and that the measured output 85 db below the reference level was hum and noise. Beyond 7000 CPS the output rose to about 70 db below reference level and dropped slowly above 10,000 CPS. The insertion loss of this filter is 7 db; that is, the output voltage at 100 CPS is 7 db less than the input voltage. This loss is a consequence mainly of the resistance of the choke coils used.

APPLICATION

The maximum operating level for the filter is 10 volts RMS at the input. Operation at higher levels will introduce distortion due to overloading of the input triode. Practical operating levels will range between 1 and 10 volts. Operation at lower levels will, of course, degrade the signal-to-hum ratio. It will be observed that the hum level in the output is determined by the amount of stray magnetic field in the vicinity of the filter since the coils are not magnetically shielded. A power supply is not included as part of the filter for this reason. Ordinarily, the small amount of heater and plate power required can be borrowed from other apparatus with which the unit is used. If excessive hum is experienced, try moving the filter to a more favorable position, or orienting it for minimum hum pickup.

As a receiving accessory, the filter is inserted in an audio circuit where the operating levels are within range. In most receivers, the output of the first audio stage will provide a suitable signal level for the filter input. When used with the Signal Slicer (G-E HAM NEWS, Volume 6, No. 4) the filter should be inserted between the slicer output and its succeeding audio amplifier. Note that the 4700-ohm output resistor should not be short-circuited by the device into which the filter operates. A coupling capacitor with reactance equal to one-tenth the input impedance of the load at the lowest desired frequency should be provided at the input to any such load (see Fig. 1). Such a capacitor can be incorporated as part of the filter unit to avoid mistakes.

Whether the crystal filter in the receiver is used or not, this filter will improve CW reception somewhat even though the bandwidth is greater than needed for that application. The improvement obtained will depend on the characteristics of the receiver and the particular QRM problem encountered.

For use as a bandwidth control in transmission, the filter is inserted in the audio circuits at a point where the operating levels are suitable. The above precautions regarding the load circuit should be observed. When used in conjunction with the SSB Jr. exciter (G-E HAM NEWS, Volume 5, No. 6) the filter output can connect directly to the audio input jack of the exciter if an 0.01 mfd coupling condenser is inserted in either the filter output or exciter input.

The filter characteristics do not provide for attenuation of low frequencies. Where it is desired to tailor the audio response of the transmitter, this may be done in the circuits either preceding or following the filter. When low-frequency attenuation is introduced after the filter, hum pickup in the filter itself will be attenuated. (See G-E HAM NEWS, Volume 4, No. 4, for simple means of introducing low-frequency attenuation in speech amplifier circuits.)

The "dyed-in-the-wool" experimenter will find many other applications for a handy sharp cut-off filter such as the one described here. Even though the filter is normally used in only one place (say as part of the receiver setup) it will be found convenient to provide input and output jacks so that the device may be patched into other apparatus as the need occurs. In this way a single filter can be made to serve a variety of uses.

THUMBNAIL THEORY

The design of filters can not be covered very thoroughly in a few paragraphs. For those who want some background information on filters the following will be of interest.

The basic filter section used in the device described in this issue is called the "constant K prototype," shown in Fig. 7. Any number of these sections may be joined together for greater attenuation beyond the cut-off frequency. When this is done, the internal sections can be considered as either π or T sections. A multiple section filter is called a "composite" filter. In the ideal case, a constant K filter must be driven by a source having an internal impedance equal to the characteristic impedance of the filter section and the filter must be terminated by the same impedance. Ideally, too, the filter elements should be perfect reactances. Practically speaking, the characteristic impedance varies throughout the pass-band of the filter. Of course, the filter elements do have loss (they are not perfect reactances) so that other considerations

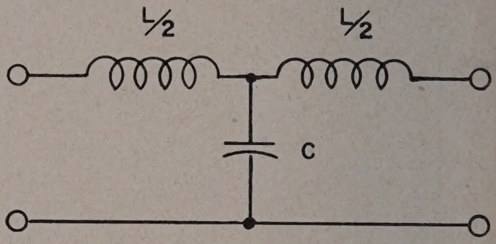
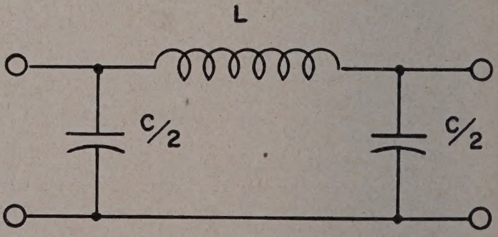


Fig. 7 Above is a T structure filter section. When several T's or π's are joined in a complete filter, the internal sections lose their identity.

Fig. 8 Below is a π structure filter section.



(continued on page 8)

SWEEPING *the* SPECTRUM

Doggone it!—I just get one editor really broken in that everything here at the G-E HAM NEWS ffice is running smoothly when he turns around and nds a new job. W2ZBY will be in charge of the Tube epartment News Bureau which is now being organ-ed. This new man, W2JZK, looks like a real tough oy to work for. No more "coffee breaks" for me for while until I get him whittled down to size. Anyway, est wishes for success to W2ZBY in his new venture.

* * *

Our editor is constantly checking with the "un-fficial" technical staff here at General Electric to see hat interesting gear or subjects they have in mind. hese projects are intended to have wide popular ppeal. Therefore, each one must be fairly easy to onstruct using standard manufactured parts unless e performance requirements dictate some special omponent. We receive letters every day asking when e are going to publish a specific design. Ideas for ture issues are largely initiated by such communica-ons, so if you haven't seen what you would like to uild in G-E HAM NEWS, write and present your oughts on the subject.

* * *

THE RADAR MAN

If you should see upon the street
A man who walks with dipole feet,
With a train of little pips behind
He's a radar man with a micro-mind.

With micro-seconds and micro-waves
And micro-volts he fills his days.
And thus in the course of time we find
His brain has shrunk to a micro-mind.

His eyes give out a neon gleam
His ears fan out like a radio beam
As he chews, his molars oscillate
And his heart pumps blood at a video rate.

This man obtains with passing years
Infinite impedance between his ears
And at last he succumbs to a heavy jolt
When he gets what he thinks is a micro-volt.

The doc looks up from his microscope
And says to his nurse, behold this dope.
No trace of a brain cell, can I find
He's a Radar Man with a micro-mind!

—W0PPX in "Ham Hum"
Ak-Sar-Ben—R. C., W0EQU

The G-E HAM NEWS photographer is now out in San Diego County, Calif., getting some pictures of 1954 Edison Radio Amateur Award winner Ben Hamilton, W6VFT, in action at his outstanding civil defense and disaster service installations. Look for them in the next issue of G-E HAM NEWS.

* * *

The Edison Radio Amateur Award judges also named two other nominees, Carl J. Theis, W8BKH, and Carter Rogers, W8NCS, for Special Citation award certificates.

Theis, of Cleveland, Ohio, has received much acclaim for his work of designing, converting and constructing two-way radio equipment from war-surplus command sets for use by missionaries overseas. More rapid communication between isolated missions made possible by these sets was instrumental in summoning life-saving medical aid on several occasions.

When his home town of Richwood, West Virginia, was cut off from the rest of the area by a flash flood and power failure, Rogers was able to enlist the aid of the necessary disaster services through use of a friend's mobile amateur radio station. A more serious threat to the flood-ravaged town was averted through his prompt action.

* * *

One of the complaints our new boss often airs is that his typewriter is old and rickety. (Please note: the typewriter—and only the typewriter—is old and rickety.) It does strange things, this machine. And the latest was to coin a word, "mudulation," which could come into common use on the ham bands. It could be used to describe the system by which all too often we produce a Q 1— R 1 signal!

* * *

About back copies of G-E HAM NEWS . . . We still have available back copies of some issues in sufficient supply to send bulk quantities to clubs or Hamfests. Drop us a note and we'll be glad to send whatever quantity you need as long as the supply lasts.

* * *

The mail basket informs us that somewhere in the land there is an occasional victim of the editorial abbreviation style used in G-E HAM NEWS. Hereafter, the said style will be altered to include the spelling out of abbreviations such as SSB, SSSC, DSRC, etc., the first time they are used in a particular issue. (Sincere apologies to anonymous.)

—Lighthouse Larry

THUMBNAIL THEORY (continued from page 6)

enter into the design of filters. Even when perfect filter elements are assumed, the variation of characteristic impedance within the pass-band presents a problem that is solved partially by more complex circuit arrangements known as "M-derived" filters.

In filter design, as in most things, a compromise must be made between performance and complexity, or cost. In our case, certain liberties were taken with classical filter theory to provide acceptably good performance with basically straightforward and simple circuits. A low source impedance is provided by the cathode follower input arrangement shown in the schematic diagram, while the terminating impedance is a resistor of a constant value. These departures cause minor variations of the attenuation within the pass-band. Fortunately, these variations are partially smoothed out by the loss in the filter coils and the approach to ideal operation is thereby improved. Non-ideal filter elements can be used with considerable saving in cost and a less complex filter arrangement can be built. The loss in the coils accounts for the bulk of the "insertion loss" mentioned earlier. About 2 db of the insertion loss is accounted for by the two tube sections used.

The composite filter in this article comprises three identical T sections joined together. Since a low driving impedance is used, no advantage could be achieved by a π structure. Rather than select a certain characteristic impedance and then prune commercial coils to necessary values in order to provide the desired cut-off frequency, the design equation for inductance *per section* was solved for R_0, the low-frequency characteristic impedance. Thus:

(1) $R_0 = \pi f c L$, where fc is the cut-off frequency and L is twice the inductance value obtainable. When fc=3000 CPS, then L=0.25 henry.

(2) $R_0 = \pi \times 3000 \times 0.25 = 2360$ ohms. Keeping fc at 30
CPS, and using $R_0 = 2360$ ohms

$$(3)\ C = \frac{1}{\pi f c R_0} = \frac{1}{\pi \times 3000 \times 2360} = 0.000000045 \text{ farads.}$$

Thus C=0.045 microfarads.

Equations (1) and (3) can be used in designing lo pass filter sections for other cut-off frequencies desired. A filter is said to "cut-off" when its attenuati reaches 3 db.

The coils used in the sample filter had an inductan value of 0.125 henry each. The measured Q at 10 CPS was 2.20. The total value of 0.25 henry requir per section is twice the value of the individual co obtainable. The filter capacitors were made up of tw selected commercial plastic-encased paper capacito connected in parallel to provide the calculated val of 0.045 ufd. The individual capacitors were check for value and paired for as nearly matched composi values as possible, as well as adherence to the desi value required.

The sharpness of cut-off obtained with this filter greater than that indicated by classical filter theo when constant resistive source and load impedanc of the value R_0 are used. This greater attenuation paid for by the irregularities shown between 1000 a 2500 CPS, a really small price indeed. The addition attenuation obtained beyond the 40 db point coupling between L_1 and L_6 to provide "infinite attenuation at 7000 CPS serves to increase the slo of the characteristic between 4000 and 7000 CPS the expense of smaller attenuation beyond about 10,0 CPS. Although this actual difference is measurabl its practical significance for most applications is ve small.

—W2K

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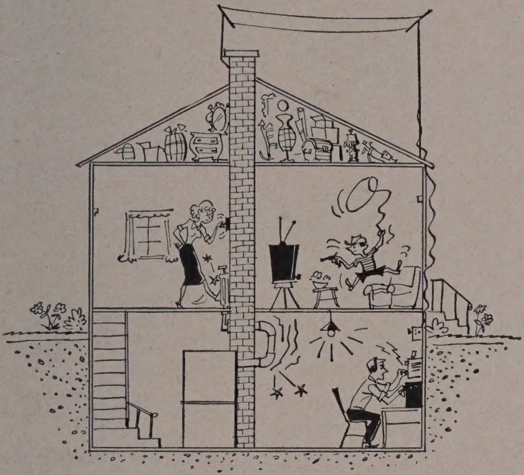
MAY–JUNE, 1955

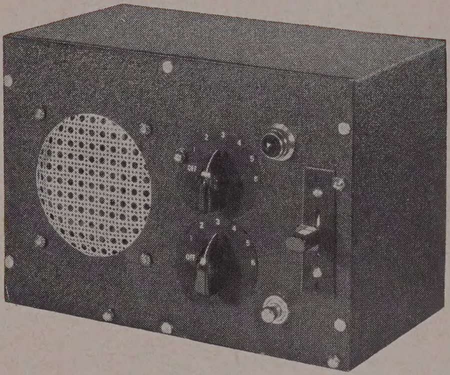
VOL. 10–NO. 3

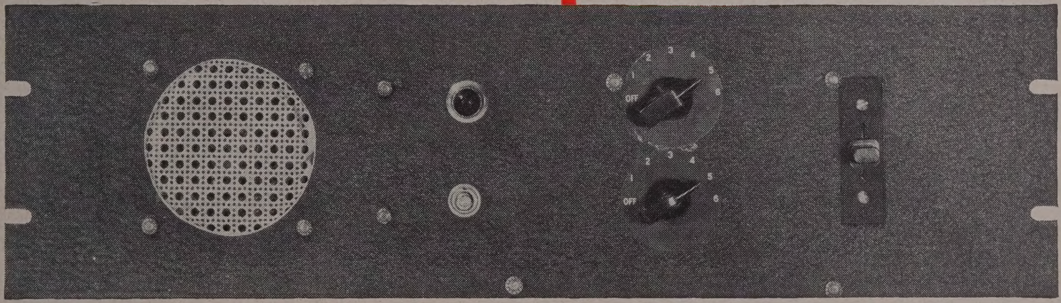
HAM SHACK INTERCOM



Did you know that pipe-pounding and light-flicking intercom systems are obsolete? Try this efficient, all-electronic model and promote peace with the family.

—*Lighthouse Larry*





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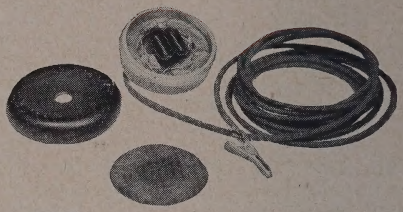
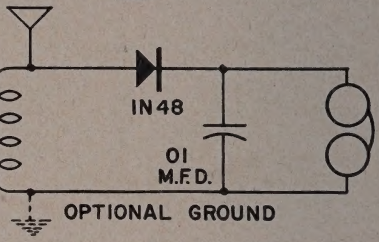
OPERATION CRYSTAL

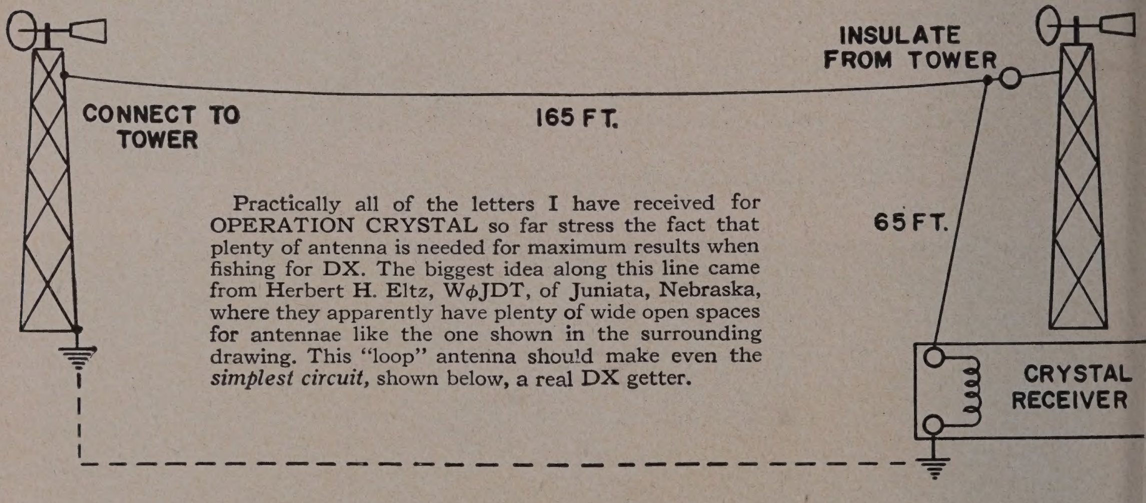
Checking the operation of this "earphone chassis" model sent me digging into my old junk box to find the necessary material. Out came a plastic-cased earphone instead of the metal one shown in the original model built by Edgar M. Weed, K2BO, of Morris Plains 22, N. J.

A pi from a mangled 2.5 mh RF choke was connected as a self-resonant coil in the illustrated circuit to receive the local broadcast station operating on the 1240 KC *Conelrad* frequency. Another pi may be connected in series with the first for improved results if your local station operates below 1000 KC. For the "last ounce" in volume, a Miller type 70A slug-tuned antenna coil could be used in a large headphone case with the slug adjusted by a screwdriver through a hole in the case.

A "field" test was made by running around the neighborhood clipping the antenna lead onto fences, fire hydrants, unoccupied automobiles, and the like. A weighted length of antenna wire was even tossed over some tree branches with good results. (These tests are best made at night unless you want to convince your already skeptical neighbors that their favorite radio amateur has gone completely crazy!)

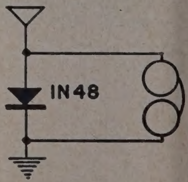






Practically all of the letters I have received for OPERATION CRYSTAL so far stress the fact that plenty of antenna is needed for maximum results when fishing for DX. The biggest idea along this line came from Herbert H. Eltz, W0JDT, of Juniata, Nebraska, where they apparently have plenty of wide open spaces for antennae like the one shown in the surrounding drawing. This "loop" antenna should make even the *simplest circuit,* shown below, a real DX getter.

This set makes up in volume and simplicity what it lacks in selectivity, according to tests run at my shack. The strongest local station will be the one that wins at the earphones. In some locations a mixture of stations will result, but that should be no problem when receiving *Conelrad.* Polarity of the crystal seems to be unimportant. Although several persons submitted this idea, Jerry Lucha, of Wilmington, Delaware, sent the first such entry to be received at my office.



All ideas submitted before December 1, 1955, will be eligible for publication in the OPERATION CRYSTAL column. (See G-E HAM NEWS, Volume 10, No. 1.) Do not send in your model! Construction and antenna hints of an outstanding nature are also eligible. All material submitted must be free of patent restrictions and becomes the property of G-E HAM NEWS.

—Danny Diode

HAM SHACK INTERCOM

What's so unusual about an inter-com system? The control circuits of this G-E HAM NEWS model are designed specifically with the "hermit" type of radio shack in mind—a good nickname for most home stations located in attics, upstairs rooms, cellars, or even an actual shack in the yard. When installed in the radio shack, rapid temper-saving communication is available to the front and rear doors, kitchen, nursery, or what-have-you. It will replace, at nominal cost, the more conventional systems of signalling the "chief op'." Banging on the floor, ceiling and plumbing, or flicking the cellar or attic light on and off would no longer be in vogue. It is also a handy gadget to have for communication between tents at the radio club's annual Field Day station.

For the "occasional" 'phone man, it could be used as a speech amplifier to drive the grid of a "clamp" tube on the screen of that tetrode final amplifier even while it is also on duty in its intended role. One position of the master station selector switch could be reserved for this application.

As a general-purpose audio amplifier, it is even handy for checking the output of the Jr. op's crystal receiver. When the XYL sees how much fun you are having with it, she is sure to want a master station for the kitchen. Keep that in mind when scrounging for the parts.

Two types of construction, rack panel and table cabinet, are described to show how the master station could fit into most styles of ham shack arrangement.

CONTROL CIRCUITS

As shown in Fig. 1, the 3PDT relay and the station selector switch, S_2, form the heart of a control system that allows the master station amplifier to be activated from any remote station simply by pressing switch S_4, to the "talk" position. This grounds one side of the heater winding and energizes the relay. A ground path provided by one relay contact then acts as a "holding" switch for the relay coil current. Heater and plate power are applied through the other two normally open contacts. The amplifier is turned off by pressing S_5, on the master station, to remove the relay coil power. The heater current must be isolated from the relay-closing circuit, otherwise the extra voltage drop through the external cable would affect the relay operation.

Up to four remote stations can be selected by S_2, the fifth position connecting all stations at once. Any remote station can call into the master station, regardless of the setting of S_2, when S_4 is in the "talk" position. The remote station signal then goes directly to the input of the amplifier whenever S_1 is in the "listen" position.

If only the master and one remote station are needed, S_2 and its associated wiring and terminal strips enclosed in the dotted lines on the diagram will not be necessary. Further simplification is possible by eliminating the control relay, if the amplifier runs continuously.

Inexpensive four-wire TV antenna rotator control cable is used to connect the master and remote stations when the complete control system is desired. The rotator cable is flat in cross-section and can easily be run around door and window casings, behind moldings and base-boards, under rugs or even fished through walls, if you are the ambitious type of person. Two or three-wire cable may be used with the simplified circuit.

AMPLIFIER CIRCUIT

A three-stage audio amplifier circuit is used, with the input signal from the speaker-microphones fed into one cathode of a 12AX7 twin-triode. This grounded-grid input circuit has less gain than conventional types, but eliminates the input matching transformer which would otherwise be necessary. Sufficient output at only 110 plate volts is possible with the new 6CA5 beam-pentode tube in the power output stage. (See G-E HAM NEWS, Volume 10, No. 1, for ratings and description.) The coupling, cathode by-pass and shunting condensers are tailored to attenuate frequencies outside the normal speech range, reducing any stray hum pickup by the remote station cables. (See G-E HAM NEWS, Volume 4, No. 4, for details.)

Expensive instant-heating type tubes were deemed unnecessary because the amplifier was found to be capable of passing a signal about 8 seconds after the relay was energized.

A transformer-powered, half-wave, selenium-rectifier plate supply with an RC filter is used to minimize the shock hazard always possible with transformerless type supplies. This also simplifies the tube heater and relay power problem. The power transformer, T_1, runs all the time that the power switch, S_3, on the volume control shaft is "on." After running several hours in the stand-by position, the transformer was barely warm. The built-in power supply can be eliminated if a similar source is available in the shack.

Standard 3.2-ohm voice-coil PM speakers could be used in place of the 45-ohm types designed especially for inter-com service if each remote station does not require over 25 feet of connecting cable. Savings in original cost would be about fifty cents per speaker.

CONSTRUCTION

All new parts were used in the model stations, but either one could be built around a "defunct" table radio chassis and cabinet. The amplifier and power supply is built on a Bud CB-1620 miniature open-end aluminum chassis drilled according to Fig. 2. All parts are arranged so that the same chassis can be mounted vertically in either a 6 x 9 x 5-inch metal utility box, or on a 5¼-inch wide relay rack panel. Station selector switch, S_2, and the volume control, R_5, mount with the shafts projecting through the underside of the chassis. Five 3-terminal tie-points are fastened under the chassis at the places shown in the bottom view, Fig. 3, when the transformers and sockets are assembled with 6–32 x ¼-inch and 4–40 x ¼-inch machine screws. Soldering lugs are also placed on these screws for ground tie-points. Rubber grommets are used in the six ⅜-inch diameter holes marked "D" where leads from the transformers, switches and volume control pass through the chassis.

All wiring is done with conventional colored hook-up wire, as no shielded leads were found necessary. The wires to the speaker, S_1, S_5 and the pilot-light bracket are left a few inches longer than necessary. These parts are then fastened to the panel, drilled as shown in Fig. 4, before the chassis is assembled with ¾-inch long tubular metal spacers between the bottom lip of the chassis and the panel. Note that blank spaces are left under the chassis where the panel-mounted parts are located. As the power relay mounts on the bottom of the box next to the chassis, connections made to it were left slightly long and then laced together. Small rubber feet, ⅜-inches in diameter, fastened on the bottom of the cabinet, provide clearance for the relay mounting screw-heads. The terminal strips for connecting to the remote stations were mounted directly on the back of the cabinet. Leads from the strips to S_2 and the relay are made long enough to allow the back to be opened with the chassis in place.

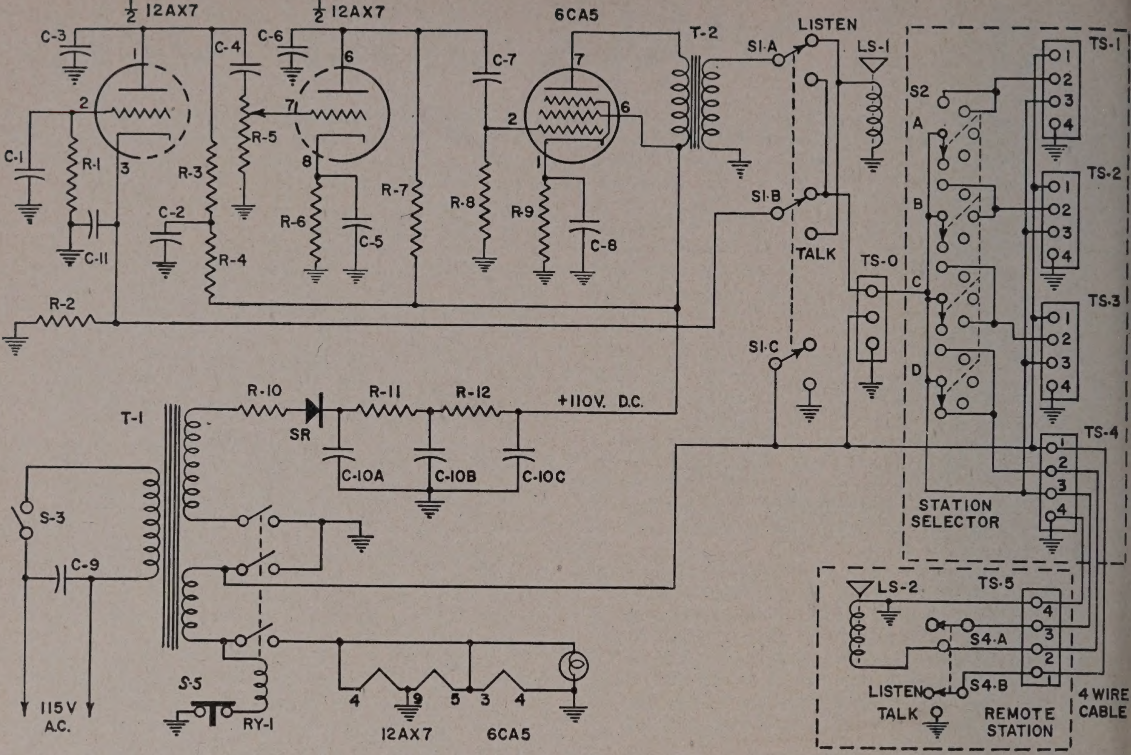

½ 12AX7
½ 12AX7
6CA5
C-1
C-2
C-3
C-4
C-5
C-6
C-7
C-8
C-9
C-10A
C-10B
C-10C
C-11
R-1
R-2
R-3
R-4
R-5
R-6
R-7
R-8
R-9
R-10
R-11
R-12
T-1
T-2
SR
+110V. D.C.
S-3
S-5
RY-1
115 V A.C.
12AX7
6CA5
LISTEN
TALK
S1-A
S1-B
S1-C
LS-1
LS-2
S2
A
B
C
D
TS-0
TS-1
TS-2
TS-3
TS-4
TS-5
S4-A
S4-B
STATION SELECTOR
REMOTE STATION
4 WIRE CABLE

Fig. 1 Schematic diagram

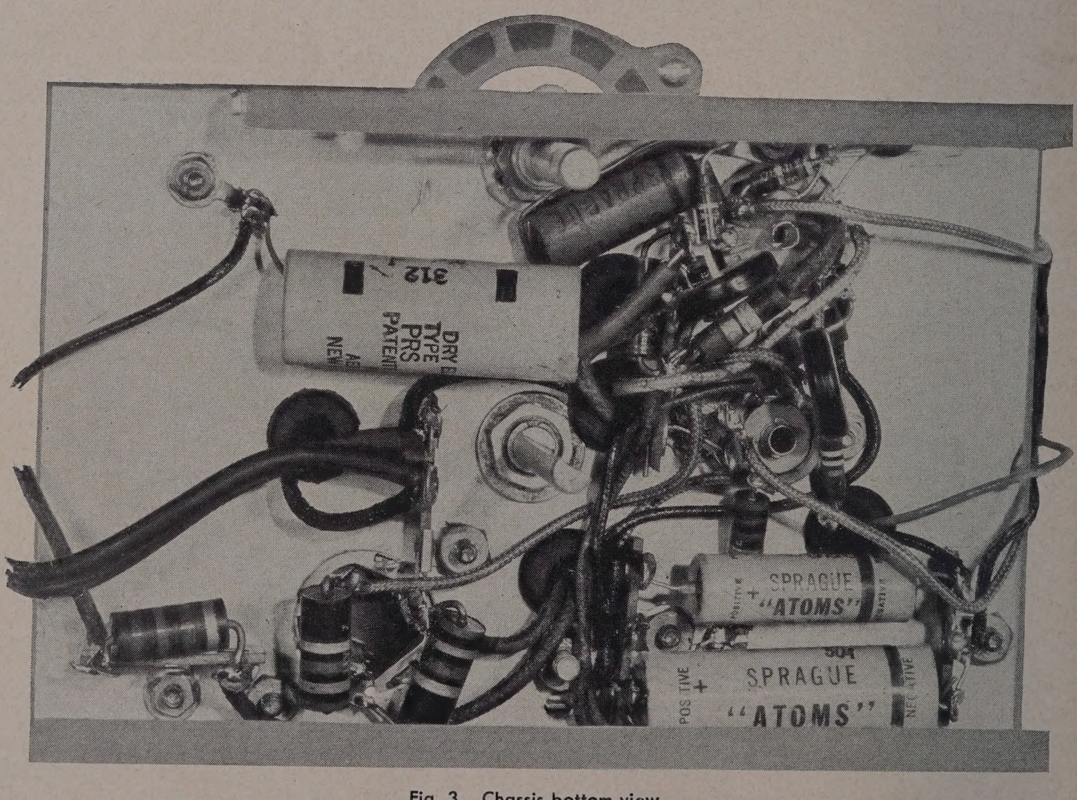

312
DRY TYPE PRS PATENT
SPRAGUE "ATOMS"
SPRAGUE "ATOMS"

Fig. 3 Chassis bottom view

"A" drill—No. 32 spaced to suit tube sockets.

"B" drill—No. 26 through both chassis and bottom lip.

"C" drill—No. 26 for T$_2$ at left, T$_1$ at right, C$_{10}$ at ⅞-inch hole and rectifier at bottom center.

"D" drill—⅜-in. dia for rubber grommets.

"E" drill—⅜-in. dia for R$_5$ and S$_2$.

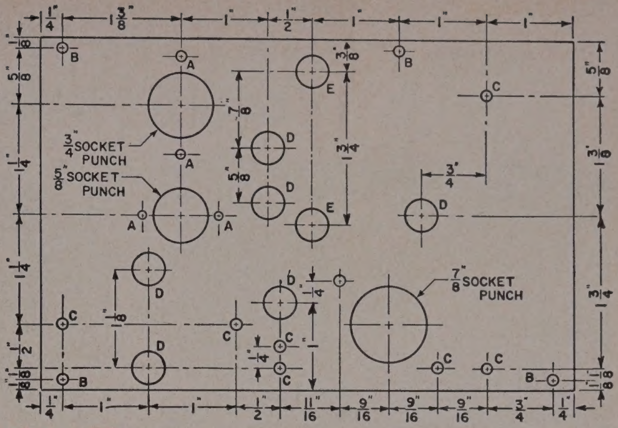


Fig. 2 Chassis drilling layout (top view)

PARTS LIST

C$_1$—0.1-mfd, 200-volt paper.
C$_2$—10-mfd, 150-volt miniature electrolytic.
C$_3$, C$_6$—500-mmf, 500-volt disc ceramic.
C$_4$, C$_7$—2000-mmf, 500-volt disc ceramic.
C$_5$—10-mfd, 50-volt miniature electrolytic.
C$_8$—50-mfd, 50-volt miniature electrolytic.
C$_9$—0.05-mfd, 600-volt paper.
C$_{10a,b,c}$—Three-section, 40-mfd, 150-volt electrolytic, "twist-lock" type not over 3 inches high.
C$_{11}$—5000-mmf, 500-volt disc ceramic.
I$_1$—½-inch jeweled pilot light and bracket.
LS$_1$, LS$_2$—4-inch PM speakers, 45-ohm voice coils (QUAM 4A07Z45 or similar).
R$_1$—10-megohm, ½-watt.
R$_2$—470-ohm, ½-watt.
R$_3$, R$_7$—0.1-megohm, ½-watt.
R$_4$, R$_6$—2200-ohm, 1-watt.
R$_5$—0.25-megohm potentiometer with SPST switch.
R$_8$—0.24-megohm, ½-watt.
R$_9$—120-ohm, 1-watt.
R$_{10}$—100-ohm, 2-watt.
R$_{11}$, R$_{12}$—180-ohm, 2-watt.
RY$_1$—3PDT, 6-volt AC coil relay (Potter & Brumfield KR-14A 6-volt AC coil).
S$_1$—4-pole, 2-position, non-shorting, spring return lever switch.
S$_2$—4-pole, 5-position, shorting rotary switch.
S$_3$—SPST switch on back of potentiometer R$_5$.
S$_4$—2-pole, 2-position, non-shorting, spring return lever switch.
S$_5$—SPST, normally closed push-button switch.
SR—130-volt, 75 ma, half-wave selenium rectifier.
T$_1$—Half-wave power transformer, 125 volts @ 50 ma, 6.3 volts @ 2 amp. secondaries.
T$_2$—4-watt universal output transformer, connected to match speakers used.
TS$_{1\text{-}5}$—4-terminal and lug phenolic strips.
TS$_0$—optional strip when S$_2$ is not needed.
Dial plates: (1) 5-position tap switch plate (Mallory No. 375).
(1) OFF and10-position volume control plate (Mallory No. 390).
(2) Single gang lever-switch plates (Centralab P-1755).

The above description also applies if the chassis will be housed in a small table radio cabinet, except that small blocks of ¾-inch thick white-pine are glued to the inside of the panel and 1½-inch long wood screws fasten the chassis to the blocks from the rear. A back cover of ⅛-inch thick tempered hard-board with the terminal strips mounted on it is then fashioned.

RELAY RACK MODEL

The amplifier chassis bolts directly to the rear of the relay rack panel, with the control shafts located about 2 inches off-center. The lower edge of the chassis comes flush with the same edge of the panel. The speaker, S$_1$, S$_5$, power relay and pilot-light bracket are fastened to unused portions of the panel either side of the chassis. The speaker is centered about 4 inches from one end of the panel and the relay positioned next to it. The pilot-light bracket and S$_5$ are located in line with the control shafts between the chassis and relay. Talk-listen switch, S$_1$, mounts about 1 inch from the other end of the chassis. Ornamental-head screws are used wherever the heads show on the front of the panel.

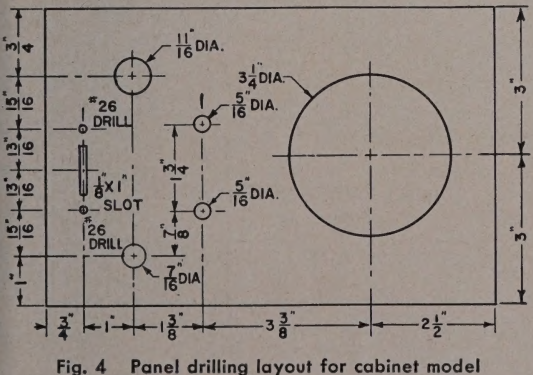


Fig. 4 Panel drilling layout for cabinet model

A decorative pattern of holes drilled through the panel can be used as a speaker grille, or a small piece of "do-it-yourself" perforated aluminum sheet can be used between the speaker and a 3¼-inch diameter hole bored through the panel. A "dished" effect was obtained by gently tapping the sheet with an object slightly smaller than the hole. Standard lever and rotary switch plates identify the various controls.

The terminal strips were mounted on a small piece of hard-board and fastened to a pair of small angle brackets assembled under the chassis mounting screws.

REMOTE STATIONS

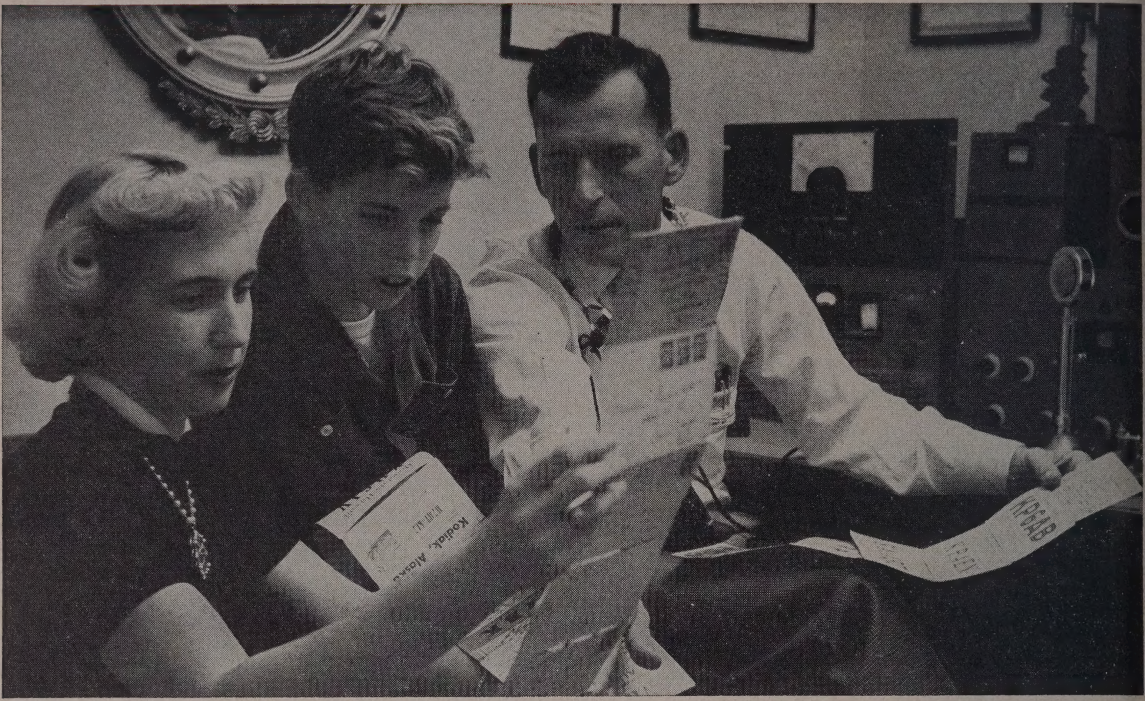
A Bud CS-1948 4-inch metal speaker cabinet houses each remote speaker and the call-in switch, S$_4$. A Cinch-Jones No. 17-4 terminal strip for the external cable is mounted on the back of the box with 6–32 x ¼-inch machine screws. Note that the cabinet is grounded to the terminal strip.

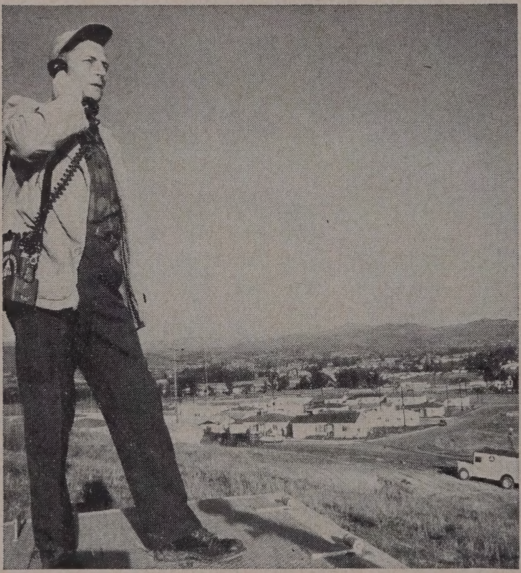
Many other possible uses will probably occur that have not been mentioned in this description, although our few examples show that an inter-com system is a necessity in many amateur radio installations.

1954 EDISON AMATEUR RADIO AWARD WINNER

Judges:

Val Peterson, Administrator, FCDA
E. Roland Harriman, President, Red Cross
Edward M. Webster, Commissioner, FCC
Goodwin L. Dosland, President, ARRL





Ben Hamilton, W6VFT, shown with XYL Flora Mae and son Richard at his La Mesa, Calif., home station (top), catches a moment's relaxation from activities which consume more than 20 hours weekly in addition to his career as industrial electronics instructor at San Diego Junior College and Vocational School. The Civil Defense control center (upper right) co-ordinates operation of nets for CD, Zone Warden, Red Cross disaster service, county road service, and AREC in 36 of 44 communities in 60 by 70-mile San Diego County. Four bands are used to insure adequat coverage of rugged mountains, coastal, and desert terrai (bottom left). His program of network planning; specifying installing and maintaining equipment; personnel alerting system and classwork training of operators (lower right) has given hi 750,000 neighbors one of the best such services in the nation.

Ben is communications chairman for the Red Cross chapter, SC for ARRL, communications officer in the 40th Division of the Cali fornia National Guard, and is a veteran of World War II an the Korean War.

SWEEPING *the* SPECTRUM

All the recent activity in the transistor field has ouched off a couple of interesting programs on that ubject at one of the local radio clubs, remarks our ditor . . . who is keeping an eye out for some good ransistor ham gear ideas. Most good-sized cities must ave either a manufacturer or user of transistors who night supply someone well-versed in the subject to act s a club program speaker. The subject is probably too xtensive to cover in one program—fundamentals ould be handled in one session, and applications in nother. Primary amateur interest would naturally be n the portable and miniature equipment field.

* * *

I caught our editor taking a peek at the scene of the irst live closed-circuit telecast ever made to an I.R.E. Convention on March 22nd here at the Power Tube Plant of General Electric in Schenectady, even though t took place after normal working hours. He also dug ip the information that the show was the first interity live closed-circuit telecast participated in by General Electric.

Manufacturing techniques on a new line of metal-eramic UHF Special Purpose and Transmitting tubes vere shown to a private audience in the West Ballroom f the Waldorf-Astoria Hotel in New York City, 170 niles away. Particularly impressive was a demonstraion showing a ceramic tube envelope withstanding ieat from a gas-torch that reduced a similar glass nvelope to a shapeless molten mass. “Star” of the how was the new GL-6442 UHF Lighthouse triode, itilizing 61 component parts assembled in 164 precision nechanically controlled operations which factor out ieavy reliance on operator skill. Power inputs of 12 vatts at 350 plate volts in a class C CW amplifier or scillator at frequencies up to 2500 MC are possible n grounded-grid cavity circuits. As a plate-pulsed scillator, it may be used up to 4000 MC at 3000 ositive peak plate volts. Short electron transit time, ow lead inductance and interelectrode capacities nd excellent isolation of the anode from the cathode llow efficient operation at these frequencies.

* * *

From a recent issue of the Suburban Radio Club, Ferguson, Missouri, bulletin comes word of this novel ise of a grid-dip oscillator.

A general contractor directed scathing imprecations at he carpenters, electricians and others of the construcion crew whom he condemned individually and collecively for the delays and troubles which, he roared, vere ruining him. If he could only get a little money ihead he would quit this losing game, etc. No more ustom home construction jobs for him!

“How in blue blazes are we going to find the elecric outlets that those plasterers buried so thoroughly and now have been tiled over in the kitchen? Who is going to pay for chopping up these walls?”

An electrician, also a radio ham, then advanced, “I'll bet coffee against your coffee and doughnuts that a good radio man could spot them within two inches without even scratching the paint.”

“All right, it's a deal,” said the contractor. “I will give you five minutes a plug, but heaven help you if you are giving me a wrong steer.”

It was a curious group that gathered around as ***you know who*** coupled his grid-dip meter to one of the lines in an exposed socket and picked up the signal on his little wave-meter which in turn was plugged into a large volt-ohm meter. With the aid of the swinging needle, he followed the invisible wires up the wall, across the ceiling and down the outer wall. The carpenter drove his chisel through at the indicated spot, right in the middle of an outlet box, of course. The others were uncovered in rapid succession, and once again pure genius brought home the coffee and doughnuts.

The frequency? This, our hero refused to divulge, but the real mystery seems to be: How did that grid-dip meter, wavemeter and multi-meter just happen to be so handy?

* * *

Although operation of a mobile radio station by the driver of a motor vehicle is illegal in many states, the Egyptian Radio Club of Granite City, Illinois, has established a class to teach members how to drive an automobile while talking into a microphone.

The club has set up an obstacle course on “the south ten acres” of their club grounds which duplicates the conditions encountered in city driving—rough streets, traffic snarls, baby buggies and police patrol cars. Several members have “donated” the use of their cars to simulate heavy traffic similar to that encountered while mobiling.

A beginner in the course is equipped with a chest microphone, which is used for the first three lessons, or until he shows aptitude for further learning. After the student becomes accustomed to the feel of the “mike” at his nose, a regular hand-held microphone is substituted. The instruction committee guarantees that an ERC-trained ham can talk on the mobile wireless and drive anywhere! Yes, anywhere!

In spite of such educational efforts, undoubtedly the safest and best course of action is to refrain from operating a mobile rig while actually moving, or in stop-and-go traffic. This is particularly important where a hand-held microphone is used or while attempting to tune the mobile installation. Even a minor accident, which involves no injuries, resulting from these distractions would be bad public relations for amateur radio. Also, the outcome of any civil action could be influenced by the fact that one of the parties involved did not give driving his undivided attention.

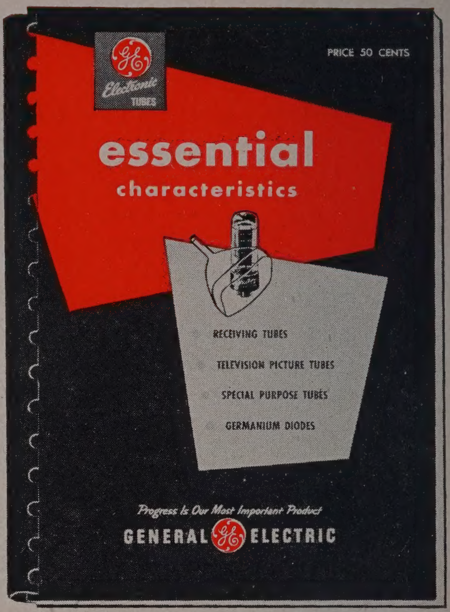
—Lighthouse Larry

essential characteristics handbook

Look for the cover pictured at the right on the counter of your local G-E Tube Distributor, who should now have his copies of the new, completely revised, G-E Receiving Tube Essential Characteristics Handbook. Latest information on over 100 new miniature, sub-miniature, series-string, special purpose and television picture tubes, plus a separate section on germanium diodes, is packed into a compact 6 x 8½-inch size. A multi-ring binder allows the book to stay open and lie flat at any page. The type style used shows at a glance whether a tube is miniature, glass or metal. A bonus feature is the printing of the base diagram on the same page as the tube listing—no tedious thumbing back and forth for this information.

Function, maximum ratings, and typical operating conditions of over 1700 tube types are listed clearly. Outline drawings with dimensions allow you to determine whether or not that 5-tube receiver will fit into your favorite-brand coffee can. A section with circuit diagrams for most typical receiving tube applications brings up the rear.

Do not write to Lighthouse Larry for your copy! They are available only through authorized G-E Tube Distributors.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MAY-JUNE, 1955

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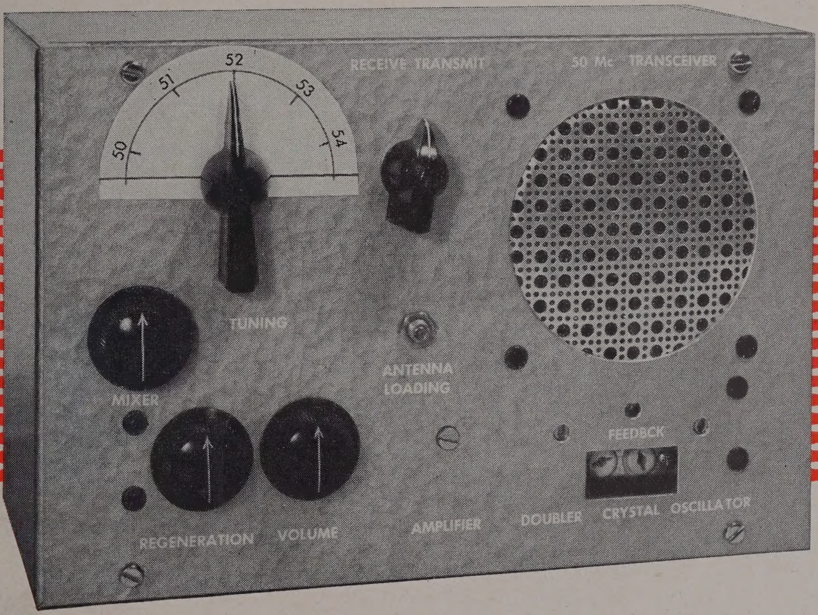
JULY–AUGUST, 1955

VOL. 10–NO. 4

A 6-METER SPECTACULAR—Part I

"TECHNICIANS' DELIGHT" TRANSCEIVER


RECEIVE TRANSMIT
50 Mc TRANSCEIVER
50
51
52
53
54
TUNING
MIXER
ANTENNA LOADING
FEEDBACK
REGENERATION
VOLUME
AMPLIFIER
DOUBLER
CRYSTAL OSCILLATOR

Part I is a complete 6-meter station in one package from the bench of W2GYV that features a simple six-tube circuit, 4.5 MC fixed-frequency superregenerative detector, speaker doubling as a microphone and a novel "pi-network" overtone oscillator circuit. The next issue will feature Part II, the "Simple-sixer Serious Converter"; and the November–December issue will present Part III, the "Bonus 100-watt Transmitter."

—Lighthouse Larry

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Technicians' Delight Transceiver . . . . page 3
Sweeping the Spectrum . . . . page 7
Transceiver Test Meter . . . . page 8

OPERATION CRYSTAL

Have you ever wondered how more than one germanium diode would work in a crystal receiver. Well, I found out when tests were made on these entries I received recently. Fig. 1 is a full-wave detector using a split coil and a 2-section tuning capacitor, which can be any old broadcast type ranging from about 10 to 400 mmf. L$_1$ is 45 turns of No. 32 insulated wire wound in the middle of a 6-inch long, $1\frac{1}{4}$-inch diameter form. L$_2$ and L$_3$ each have 140 turns wound either side and spaced $\frac{1}{8}$ inch from L$_1$. All coils are wound in the same direction. The series antenna capacitors, C$_1$, a 15–400-mmf variable, and C$_3$, a 500-mmf fixed, help resonate most any antenna and ground system. Les Trude, W2GXV, of Clyde, N. Y., submitted the first of several full-wave circuits received.

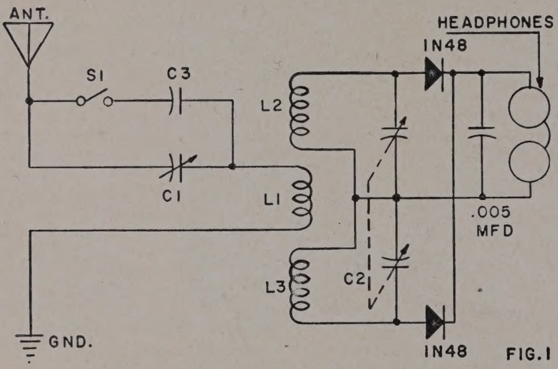

ANT.
S1
C3
C1
L2
L1
L3
C2
HEADPHONES
IN48
.005 MFD
IN48
GND.

FIG. 1

The circuit shown below makes use of a bridge-type detector circuit which, when tested, showed greater selectivity than a single crystal connected across the same tuned circuit. The audio output voltage was about the same for either detector. The selectivity becomes greater and sensitivity decreases as the spacing between the coils is increased. The two vari-loop sticks may be placed either end to end or parallel with about ½-inch spacing center to center. J. L. Knaus of Glassport, Pa., submitted this circuit.

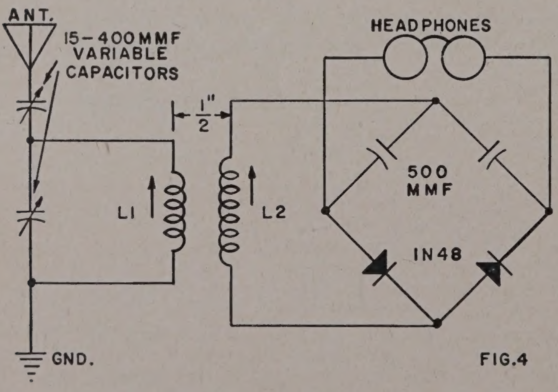

ANT.
15-400MMF VARIABLE CAPACITORS
1/2"
L1
L2
HEADPHONES
500 MMF
IN48
GND.

FIG. 4

The simplest two-crystal circuit I have received came from R. J. Baker, W8JIA, North Industry, Ohio. Several of the local hams glanced at the circuit and told me, "Impossible!! There's no ground return path." So, try it yourself. It only takes a couple minutes. If you have more than one local broadcast station, the optional tuned circuit will help separate them. Even in the form shown in the solid lines in Fig. 2, high output was obtained with only a few feet of wire for an antenna.

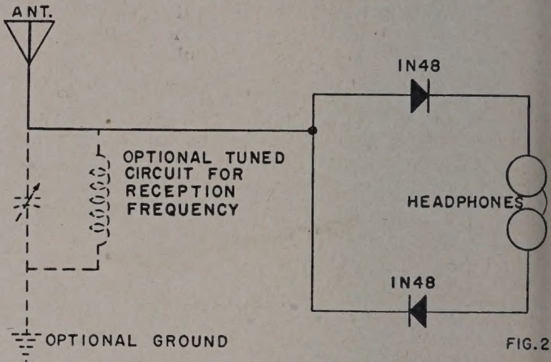

ANT.
IN48
OPTIONAL TUNED CIRCUIT FOR RECEPTION FREQUENCY
HEADPHONES
IN48
OPTIONAL GROUND

FIG. 2

W8JIA also submitted a design with one crystal and high selectivity, shown in Fig. 3. The coils are wound on a G-E tube carton $1\frac{9}{16}$-inches square. L$_1$ is 50 turns of No. 26 wire, L$_2$ is 25 turns spaced $\frac{1}{8}$ inch from L$_1$ and L$_3$ is 60 turns spaced $\frac{1}{8}$ inch from L$_2$. All the variable capacitors are separate—and for simplicity the two in the antenna circuit could be the mica-padding type.

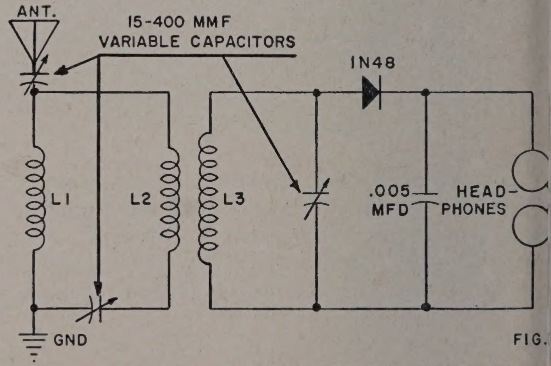

ANT.
15-400 MMF VARIABLE CAPACITORS
IN48
L1
L2
L3
.005 MFD
HEAD-PHONES
GND

FIG.

All ideas submitted before December 1, 1955, will be eligible for publication in the OPERATION CRYSTAL Column. (See G-E HAM NEWS, Volume 10, No. 1.) Do not send in your model! Submitters of the three ideas published in each issue receive certificates for $10 in G-E Electronic Tubes. Be sure to give complete coil-winding data for home-wound coils. All material submitted must be free from patent restrictions and becomes the property of G-E HAM NEWS.

—*Danny Diod*

"TECHNICIANS' DELIGHT"
TRANSCEIVER

This simple transceiver has many possibilities as a general-purpose 6-meter rig for Technician class amateur radio licensees who want to take advantage of their recently-granted privileges on this band. It should particularly interest those who have no regular station receiver into which a converter may be used.

The original idea was that a few of the local gang wanted to build these units and leave them running all the time for a little private communications network. When the first model was tested, the receiver sensitivity was well above expectations—and the rig seemed to be a *natural* for the above-mentioned purpose.

The reliable working range between two of these units over fairly level terrain using a simple ground-plane antenna at roof-top height seems to be ten to fifteen miles. This set would also be useful for CD communications installations located where only one two-way radio unit is needed. As the power requirements were tailored to fit the popular 300-volt, 100-milliampere vibrator-type plate supply, it will run for many hours on one "filling" of a storage battery. The heater power requirement is only 2.4 amperes at 6.3 volts. Total plate power drain at 300 volts is 50 ma on the "receive" position and 100 ma on the "transmit" position. The high efficiency G-E HAM NEWS Mobile Portable Power Supply described in Volume 8, No. 2, would be ideal for powering this rig from 6 volts.

RECEIVER CIRCUIT

The schematic diagram, Fig. 1, shows that only six tubes are required for this transceiver, with the audio section serving a dual role as plate modulator and receiver audio amplifier. The receiver section uses a 12AT7 mixer-oscillator with the IF output at 4.5 megacycles. The high frequency oscillator tunes on the low side of the 50 to 54 megacycle signal frequency to minimize image difficulties in areas where TV channel 2 is in use. Mixer grid circuit tuning capacitor (C_1) was not ganged to oscillator capacitor (C_3) to eliminate tracking problems. Normally, C_1 will only have to be touched when more than a half megacycle frequency change is made in the oscillator tuning.

A standard 4.5 megacycle television sound discriminator transformer couples into a fixed-frequency superregenerative detector. This circuit will be remembered by many old-timers as being notorious for radiation of "squeals" and a lack of selectivity when operated at a VHF signal frequency. Working it at 4.5 megacycles and isolating this circuit from the antenna overcomes these disadvantages. The desirable properties of good sensitivity, ignition noise rejection and inherent AVC action make possible a good performing but simple receiver circuit.

For the information of "new-timers," this detector is simply an oscillator at 4.5 megacycles in which the values of the grid resistor and capacitor have been increased to the point where a "squegging" action, or second oscillation takes place simultaneously about 20 KC. The grid capacitor accumulates a high negative charge which decreases at a slow rate through the high value grid resistor, varying the oscillator's operating point. In a normal regenerative detector, further amplification ceases when oscillations commence. The superregenerative detector can oscillate at the signal frequency only when this negative grid charge decreases to the point where the grid is no longer biased beyond cutoff. Thus, the regeneration can be greatly increased with a large amount of amplification resulting.

One half of another 12AT7 handles this function, the second section being used as an audio voltage amplifier. A 6V6 beam-pentode audio output stage provides plenty of drive for the 45-ohm voice coil, 3½-inch PM speaker.

TRANSMITTER CIRCUIT

The transmitter section uses a third 12AT7 as an overtone crystal oscillator and frequency doubler. Novel use of a pi-network tank circuit is made to provide feedback for encouraging third-overtone operation of any crystal ground for fundamental operation between 8334 and 9000 KC.

Variable air capacitor C_5 tunes the network to the 25 megacycle output frequency and mica padder capacitor C_4 allows easy and precise adjustment of the proper amount of feedback necessary for overtone output from highly active or extremely sluggish crystals. Tests indicate that this circuit is much simpler to adjust than more conventional types in which juggling a coil-tap or separate feedback coil is required. Feedback is at a minimum when this padder is at maximum capacity.

The other half of this 12AT7 in a conventional frequency doubler provides about 3 ma grid current for the 5763 Class C power amplifier.

Another pi-network tank circuit is used for the amplifier output, to simplify the problem of providing mechanical means of varying the antenna loading. Parallel feed is used to isolate the plate voltage from the output circuit. While a conventional parallel-tuned tank circuit with a balanced link output might be more desirable for feeding the rig into a 300-ohm twin-lead, the unbalanced output circuit can be fed into a small antenna coupler or line-balancing balun made from coaxial cable. Antenna switching to the receiver input is also handled more easily with the unbalanced circuit.

As a safety measure, enough cathode bias is provided on each transmitter stage to keep the plate dissipation within reason when no crystal is plugged in or the tank circuits are off resonance.

Provision for metering the doubler and amplifier grid currents, the amplifier cathode current and the plate supply voltage is made by placing appropriate resistors in these circuits. Leads from these resistors connect to an octal socket installed in the rear of the chassis. The same test meter used with the G-E HAM NEWS 6-meter C-D transmitter (see page 8, also Volume 7, No. 1 for details) can be plugged into this socket when tuning up the transmitter. Test prods inserted in the appropriate socket holes can also be connected to the 10-volt DC scale on a multimeter.

AUDIO CIRCUITS

Plate and screen modulation of the final amplifier was felt to be more desirable for this type of transmitter, where every watt of output really counts, than the lower efficiency of *clamp-tube* modulation. The 6V6 was chosen as a Class A audio amplifier because it carries ratings up to 315 volts in this application. If the rig is to be run at 250 volts or less, the 6AQ5 miniature-tube version would suffice.

When transmitting, the speaker is switched from the secondary of the output transformer to the cathode of one section of a fourth 12AT7, which runs as grounded-grid voltage amplifier. The output of this stage feeds the voltage amplifier stage used for both receiving and transmitting. The other half of this tube is not used.

The audio output transformer, T_2, also serves as a center-tapped modulation choke. The 47-ohm resistor switched across the voice-coil winding in the "transmit" position *ties down* the secondary.

If the rig is to be used for occasional mobile operation in either an under-dash or on-the-seat installation, the speaker would be too far away from the operator to be conveniently used as a microphone. So, a closed-circuit type 'phone jack is provided in the cathode of the transmitter voltage amplifier. When a single-button carbon microphone is plugged in, the speaker is dis-

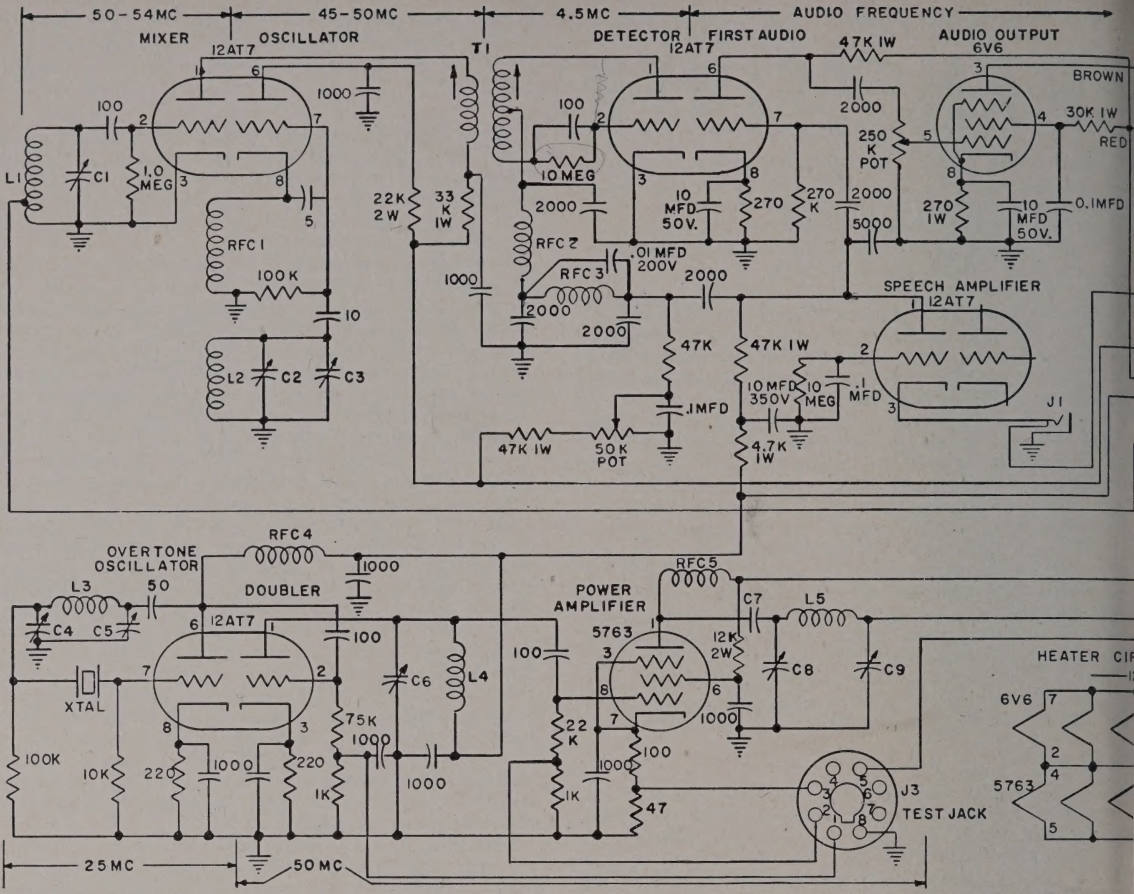

50-54MC
45-50MC
4.5MC
AUDIO FREQUENCY
MIXER
12AT7
OSCILLATOR
T1
DETECTOR
FIRST AUDIO
12AT7
47K 1W
AUDIO OUTPUT
6V6
BROWN
30K 1W
RED
0.1MFD
L1
C1
1.0 MEG
RFC1
100K
L2
C2
C3
22K 2W
33 K 1W
10 MEG
RFC2
RFC3
.01 MFD 200V
10 MFD 50V.
270
270 K
250 K POT
270 1W
10 MFD 50V.
SPEECH AMPLIFIER
12AT7
47K
47K 1W
10 MFD 350V
10 MEG
.1 MFD
J1
.1MFD
47K 1W
50K POT
4.7K 1W
OVERTONE OSCILLATOR
RFC4
L3
C4
C5
XTAL
DOUBLER
12AT7
100K
10K
220
220
75K
1K
C6
L4
POWER AMPLIFIER
5763
RFC5
C7
L5
12K 2W
C8
C9
22 K
1K
100
47
J3
TEST JACK
HEATER CIR
6V6
5763
25MC
50MC

Fig. 1—Circuit diagram.

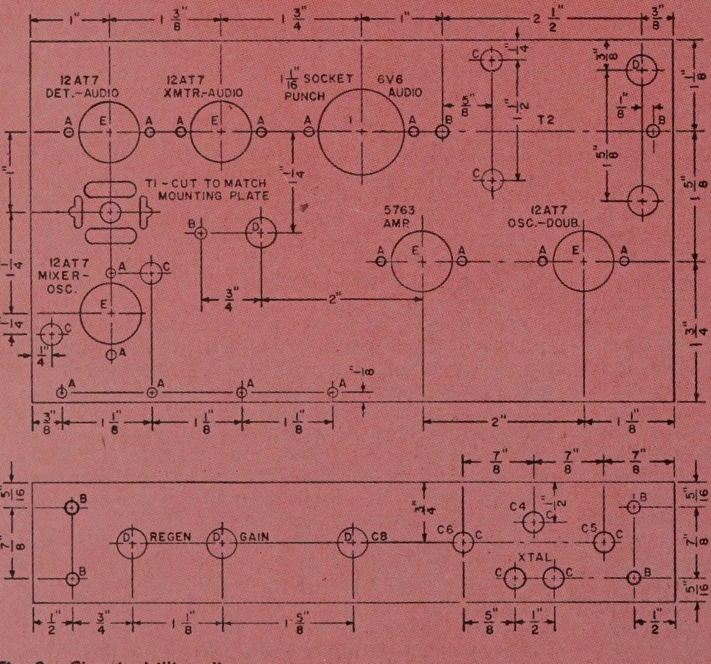

12AT7 DET.-AUDIO
12AT7 XMTR.-AUDIO
1 1/16 SOCKET PUNCH
6V6 AUDIO
T2
T1-CUT TO MATCH MOUNTING PLATE
12AT7 MIXER-OSC.
5763 AMP.
12AT7 OSC.-DOUB.
REGEN
GAIN
C8
C6
C4
C5
XTAL

Fig. 2—Chassis drilling diagram.

COIL TABLE

L_1—8 turns No. 16 enameled wire ½-inch insi 5/8-inch long—tapped 1½ turns from gr

L_2—4 turns No. 16 enameled wire ½-inch insi 3/8-inch long.

L_3—15 turns No. 16 enameled wire 5/8-inch insi 1⅛-inch long.

L_4, L_5—6 turns No. 16 enameled wire ½-inc eter—5/8-inch long, 2-inch leads on L_5.

LEGEND

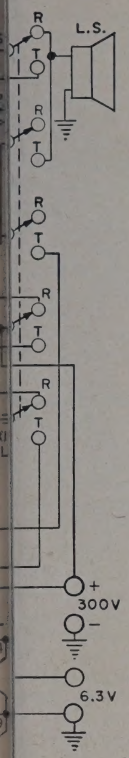
"A" drill—No. 32 spaced to fit tube sockets

"B" drill—No. 26 as shown.

"C" drill—¼-inch diameter.

"D" drill—3/8-inch diameter.

"E" socket punch—¾-inch diameter.



PARTS LIST

C_1—1.8–8.7 mmf Variable Midget Capacitor (Johnson 9 M 11 Cat. 160–104).

C_2—2.3–14.2 mmf Variable Midget Capacitor (Johnson 15 M 11 Cat. 160–107).

C_3—15–130 mmf Variable Mica Padder Capacitor (El Menco 302-M).

C_4, C_9—65–340 mmf Variable Mica Padder Capacitor (El Menco 303-M).

C_5, C_6—2.7–19.6 mmf Variable Midget Capacitor (Johnson 20 M 11 Cat. 160–110).

C_7—1000 mmf, 1000-volt working disk ceramic.

C_8—3.5–27 mmf Variable Capacitor—0.030-inch air gap (Johnson 25 L 15 Cat. 167–102).

J_1—Midget closed-circuit 'phone jack.

J_2—Chassis-type coaxial cable jack.

J_3—Octal tube socket with ground lugs.

LS—3½" PM speaker, 45-ohm voice coil.

RFC$_1$, RFC$_5$—7 uh RF choke (Ohmite Z-50).

RFC$_2$—1 mh RF choke (Miller No. 952).

RFC$_3$—16 mh RF choke (Meissner 19–1995).

RFC$_4$—1 mh RF choke (National R-100).

S_1—6-pole, 2-position steatite miniature Rotary Selector Switch, non-shorting (Centralab PA-2019).

T_1—4.5 megacycle TV Replacement Sound Discriminator Transformer (Miller No. 6204).

T_2—18-watt universal speaker output transformer (Stancor A-3852).

Xtal—Quartz crystal 8334 to 9000 KC with socket to match.

All capacitors in mmf 600-volt disk ceramic unless otherwise specified. Capacitors marked in mfd are 600-volt paper. Electrolytic capacitors are marked in mfd and voltage rating.

All resistors ½-watt unless otherwise specified. K=1000, Meg.=megohms.

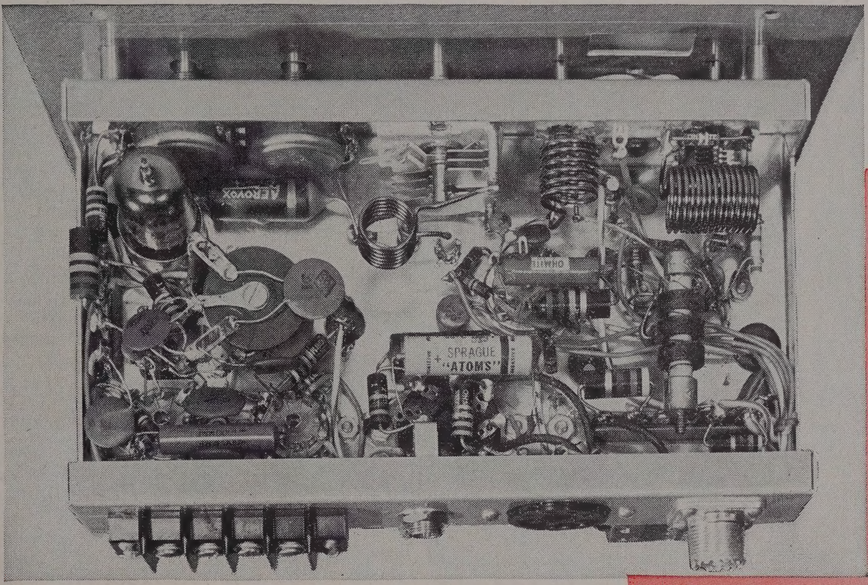


Fig. 3—Bottom view of chassis. RFC$_3$ is the large disk at the right of the inverted mixer tube.

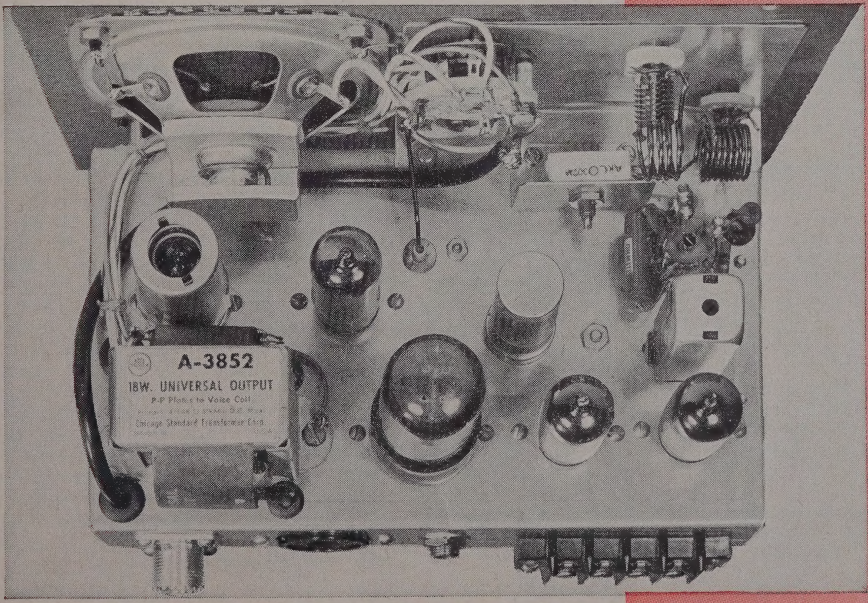


Fig. 4—Top view of chassis. A 6V6-GT audio output tube was used in the test model.

connected from this circuit. The cathode current of this stage then supplies the required microphone current.

S_1 is assigned a great variety of tasks and handles the plate supply switching job easily when ceramic insulation is used. In the "receive" position it connects the antenna to the mixer grid coil, applies plate voltage to the mixer, oscillator and detector. Also, it connects the speaker to the audio amplifier output. In the "transmit" position, it connects the antenna to the final amplifier, applies plate voltage to the oscillator-doubler, applies modulated voltage to the final amplifier plate and screen and connects the speaker as a microphone.

CONSTRUCTION

The entire gear is easily housed in a 6 x 9 x 5-inch utility box. If much portable work is planned with this unit, the aluminum box used in the cover model is preferable to a steel one, weighing about two pounds less. All parts mount on either the removable front panel or a 4½ x 8 x 1½-inch open-end aluminum chassis, drilled as shown in Fig. 2.

The mounting plate furnished with T_1 is used as a drilling and filing template to cut identical holes in the chassis and is then discarded. The transformer is then fastened directly to the chassis with the furnished spring clip.

The lower panel edge is located ¾ inch down from the bottom of the chassis and matching ¼-inch holes are drilled for all parts except the crystal socket. A ½ x 1¼-inch panel cutout allows the crystal to be plugged in. Holes for C_2 and S_1 are located 1½ inches down from the panel top edge, with C_2 2¼ inches in from the side. S_1 is centered on the panel and C_9 locates 1¾ inches directly below it. C_1 is mounted 1⅛ inches from the panel edge and 1½ inches below C_3.

A piece of thin sheet aluminum, 4 x 4 inches, bent into an angle bracket and fastened to the front of the chassis, provides a good RF ground path for C_1, C_2, C_9 and S_1. C_3 mounts on another small aluminum angle bracket fastened with the same screws which hold the larger bracket.

A 3-inch diameter hole for the speaker is bored in the panel with a circle cutter centered 2⅛ inches down and 2¼ inches in from the panel edges, and covered with a small square of perforated do-it-yourself aluminum sheet.

All parts can now be fastened to the chassis front edge and the panel mounted after ⅜-inch long spacers cut from ¼-inch OD tubing are slipped over the 6–32 x ¾-inch long machine screws. Both potentiometer shafts are trimmed to protrude about ⅝ of an inch.

Both RFC_2 and RFC_3 fasten on a single 6–32 x 1½-inch long machine screw as shown in the bottom view, Fig. 3. The mixer-oscillator tube socket is inverted to allow short RF leads pictured in the top view, Fig. 4. The larger capacitors and resistors fasten to a 4- and a 6-terminal tie-point fastened under convenient mounting screws. The power terminal strip, microphone jack, metering socket and antenna connector mount on the rear of the chassis and matching holes are cut in the back cover of the utility box to clear these parts.

Power and audio wiring connections to S_1 are laced and run through two rubber grommets near T_2 and along the edge of the chassis to the switch, to avoid the RF circuits. All coils are air-wound and mount directly on their associated tuning capacitors. One end of L_4 is connected to a tie-point terminal so that the 1000-mmf by-pass capacitor and plate voltage lead can be wired. Short leads connect the antenna transfer switch section to loading capacitor C_9 and the tap on mixer grid coil L_1. A short length of RG-58/U coaxial cable connects the switch and antenna connector J_2.

RECEIVER ADJUSTMENT

The heater wiring should be tested before the rest of the wiring is completed so that any alterations can be made more easily. Before plate power is applied, a calibrated grid-dip oscillator is very handy for adjusting the tuned circuits to the correct frequency range. With C_2 set at the proper point, C_3 should tune the oscillator between 45 and 50 megacycles with the constants shown. Switch S_1 can now be set in the "receive" position, with the mixer-oscillator tube removed and plate voltage applied to the unit. With the volume control set at the mid-position, the 50,000-ohm potentiometer controlling the superregenerative detector plate voltage should be advanced until a sharp hiss becomes noticeable. If no hiss is present, a grid-dip oscillator or other signal generator should be closely coupled to the detector and tuned from approximately 4 to 5 megacycles to see if a beat-note can be heard when the plate-voltage control is fully advanced. If this is the case, a higher resistance than the 10 megohms specified may be necessary to initiate a superregenerative type oscillation. RFC_3 and its associated by-pass capacitors form a filter that keeps the quench oscillation out of the audio circuits.

If a signal generator is not readily available, two or three feet of wire clipped on pin 6 of the mixer tube socket should provide enough pickup of outside signals in the 4 to 5 megacycle range to check the operation of the detector. The mixer-oscillator tube then can be inserted and the detector set to a clear frequency by tuning the slug on the bottom of the IF transformer. The mixer plate circuit slug on the top of the transformer should then be tuned until the detector goes out of oscillation when the resonant frequency is passed. Raising the detector plate voltage slightly should again cause the detector to oscillate. With the detector grid circuit values specified, oscillation should begin when the plate-voltage control is advanced about halfway. On the test model, a reading of 60 volts was measured at the center tap of the IF transformer secondary.

Dial calibration of the receiver oscillator can best be done with harmonics of a crystal frequency standard or signals of known frequency.

TRANSMITTER ADJUSTMENT

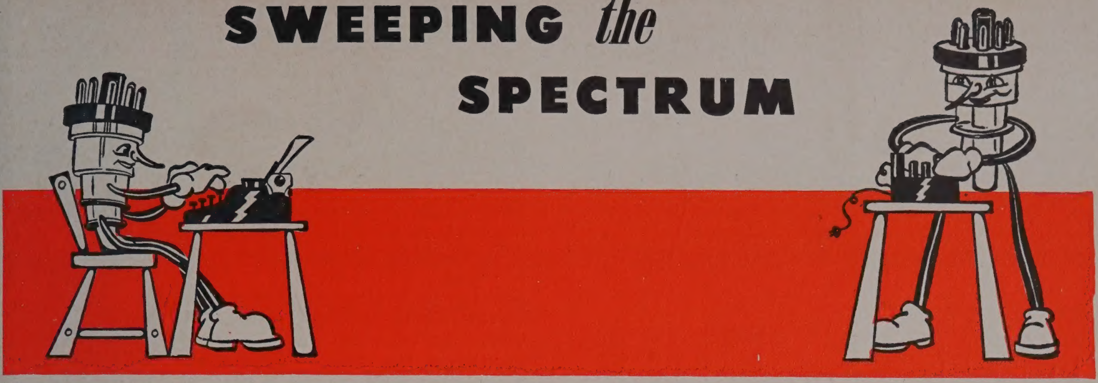
The test meter, shown in Fig. 5, can now be plugged into the metering socket, with the selector switch set on position one. The 12AT7 oscillator-doubler and 5763 amplifier tubes are inserted in their sockets and S_1 turned to the "transmit" position. A fundamental type crystal between 8334 and 9000 KC or a third-overtone crystal between 25 and 27 megacycles is plugged into the crystal socket. Feedback capacitor C_4 is then set about two turns from maximum capacity and oscillator tuning capacitor C_5 rotated until a reading of 2 to 3 grid ma is noted in the 0- to 10-ma range of the test meter. Then the feedback capacitor can be slowly adjusted for increasing capacity until oscillation stops. The final setting should be about one-quarter turn toward minimum capacity from this point. The test meter should now be set on position two, also a 10-ma scale. A sharp increase in amplifier grid current should be noted when doubler tuning capacitor C_6 is next adjusted.

The test meter is now set on position three, which reads the amplifier cathode current. A dummy load made from six 330-ohm, 2-watt composition resistors in parallel is connected to the antenna terminal.

With loading capacitor C_9 set at maximum capacity, C_8 is tuned to resonance. A reading of about 30 ma should be noted on the 100-ma full-scale meter range in position three. Capacitor C_9 should then be slowly decreased in capacity, keeping C_8 tuned for minimum cathode current, until the meter reads about 50 ma. After subtracting screen and grid currents, this indicates a plate input of 12 watts with a 300-volt plate supply. The test model delivered more than 7 watts output to a 52-ohm load when checked in the laboratory.

Two self-tapping screws driven from the back cover to the rear of the chassis when the gear is placed in the box will make the unit rigid.

SWEEPING *the* SPECTRUM



If you have thumbed through a recent receiving tube price list or characteristics handbook, several bewildering new type numbers may have come to your attention. Most of these additions are the result of tube manufacturers' attempts to cater to the demands of the television industry for tubes that will handle special color-TV applications as well as give better performance and longer life in any receiver.

With the introduction of 600-milliampere tubes specifically for series heater circuit operation, some confusion has resulted in regards to interchangeability with their prototypes. Also, the use of suffixes A and B, in addition to the common ones of G and GT, has raised some questions as to their meaning.

The following is an attempt to clarify these questions.

One—All types that originally had 600-milliampere heaters which were used in series receivers were revised only to the extent of controlling the heater warm-up time. In these cases the suffix A or B *may* indicate such a feature, but to avoid confusion can be disregarded as all future production of such types will have only the new heater. Examples are the 6S4A and 6SN7-GTB. Obviously, no problem exists in using any types in parallel-connected receivers but use of any old type tube numbers (e.g., 6S4, 6SN7-GTA) in series-string receivers is not recommended.

Two—All types that originally did not have 600-milliampere heaters but were desired for use in series sets had to be registered as an entirely new type and as such will have the controlled heater warm-up characteristic. Examples are the 5BK7A and 2AF4A. In these cases the suffix has no meaning in connection with heater characteristics.

Three—It is safe to assume that any 600-milliampere heater rated receiving type that may be developed in the future will have a controlled heater warm-up characteristic regardless of its intended application, consequently no suffix would be used in the original registration. Example—6AU8.

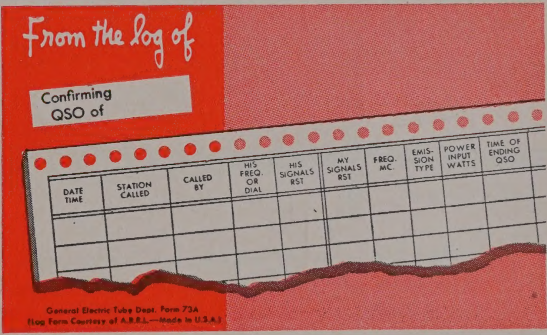
From the above it is apparent that use of *suffixes A and B have no consistent meaning except as an indication of the order in which they were assigned numbers by the Radio Electronic-Television Manufacturers' Association.* Their presence indicates a change has been made in the tube type but this change may be electrical, mechanical, or both. The RETMA designation system for receiving tubes states: The letters A, B, C, D, E and F assigned in that order indicate a later and modified version of a specific tube which can be substituted for any previous version but not vice-versa. As examples the 12BH7A is merely a controlled heater warm-up version of the 12BH7. The 6AF4A is a short bulb version of the 6AF4 while the 25CD6-GB is an entirely new 25-volt version of the 6CD6-G with improved electrical characteristics, controlled heater warm-up and straight-sided envelope.

Generally speaking, there should be no problem in using later designs in old equipment. The only possible difficulty would be minor mechanical, such as base clamps or withdrawing shorter tubes from recessed sockets. Future equipments present no problem as no designer would specify an obsolete type and the present rate of consumption will soon eliminate inventories of old style tubes.

* * *

Through a request for back issues of G-E HAM NEWS, existence of a unique amateur radio club has come to my attention. J. G. McKinley, Jr., W3OB, secretary of the Maritime Mobile Amateur Radio Club, states that the club publishes a periodical newsletter, but never holds a membership meeting!! Because a majority of the 150 members serve as Captains or Radio Officers on ships throughout the world, all club business has to be transacted by mail or amateur radio schedules. Instead of a "President" and "Vice-president," they have a "Commodore" and "Vice-commodore." They are: J. H. B. van Weelderen, W4RW, Captain of the *Gulf Victor;* and Kurt Carlsen, W2-ZXM, Captain of the *Flying Enterprise II,* respectively. W2ZXM is the famous, "Captain Stay-put," who remained alone aboard his storm-damaged ship off the coast of England until shortly before she sank, early in 1952.

* * *



From the log of

Confirming
QSO of

DATE TIME	STATION CALLED	CALLED BY	HIS FREQ. OR DIAL	HIS SIGNALS RST	MY SIGNALS RST	FREQ. MC.	EMIS-SION TYPE	POWER INPUT WATTS	TIME OF ENDING QSO

General Electric Tube Dept. Form 73A
(Log Form Courtesy of A.R.R.L.—Made in U.S.A.)

Would the attractive, two-color blank QSL card pictured above, designed around the standard ARRL logbook form, interest you? They would be ideal for confirming those Field Day, VHF QSO party, Sweepstakes or DX contest contacts; portable expedition or temporary location QSO's. Ample space is provided above and below the form to imprint your own call letters, name and location either by hand or with a rubber stamp. No advertising would appear on this card. If enough of you fellows want these cards, I can arrange to make them available at three hundred for a dollar—delivered postpaid. Drop me a postal card, saying "Yes" or "No," as soon as you read this!!

—*Lighthouse Larry*

Transceiver Test Meter

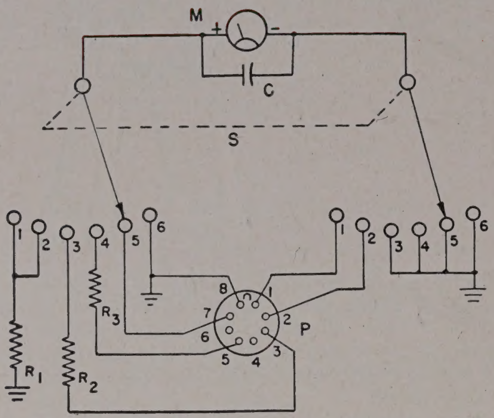


Fig. 5—Circuit diagram of test meter.

CIRCUIT CONSTANTS

C	270 mmf mica or high-K ceramic
M	0 to 1 ma d-c meter
P	Octal plug
R_1	10,000 ohm, ½ watt (see text)
R_2	5000 ohm, ½ watt (see text)
R_3	1 megohm, 1 watt (see text)
S	Two-pole, six-position rotary switch

Since the test meter for the 6-meter CD transmitter (see G-E HAM NEWS, Volume 7, No. 1, for details), met the metering requirements for this unit, the circuit, shown in Fig. 5, is being repeated for those who do not have access to this issue. A few of these meters may be available in localities where these CD rigs are in use.

In switch positions 1 and 2, the resistor R_1 causes the meter to act as a 0 to 10 voltmeter; in switch position 3, resistor R_2 makes the meter into a 0 to 5 voltmeter; in switch position 4, resistor R_3 forms a voltmeter with the range 0 to 1000 volts; in switch position 5, the meter is used as a—0 to 1 milliameter; in position 6 the meter is shorted (the recommended "off" position).

The following tabulation indicates the "current" and voltage which the meter reads when it is switched to the various positions:

Position 1: Full scale equals 10 ma doubler grid current.

Position 2: Full scale equals 10 ma final grid current.

Position 3: Full scale equals 100 ma final cathode current.

Position 4: Full scale equals 1000 volts plate voltage.

Position 5: Relative power output reading (Not used).

Position 6: Off.

For accurate scale readings, the resistors specified should be as accurate as possible. Strictly speaking, however, accuracy is not paramount, inasmuch as the metering system will undoubtedly be used mainly as a tune-up aid.

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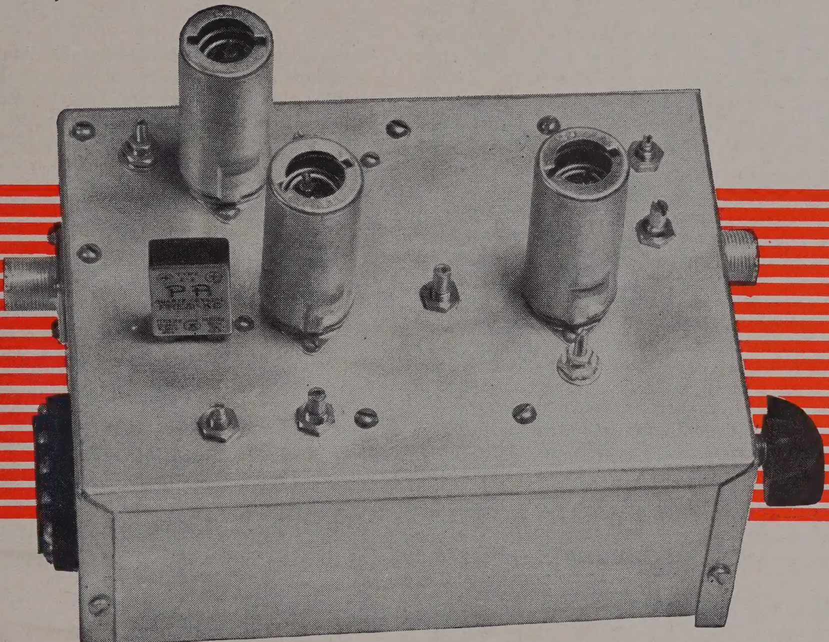
SEPTEMBER–OCTOBER, 1955 VOL. 10–NO. 5

A 6-METER SPECTACULAR—Part II

"SIMPLE-SIXER" CONVERTER



Part II is a 6-meter crystal-controlled converter that digs right down into the external noise level picked up by your antenna—rejects intermediate frequency range signals—and at the same time is simple to build and adjust. When used with the "Bonus 100" transmitter to be described in the next issue and a rotary beam antenna, some surprising contacts can be made.

—*Lighthouse Larry*

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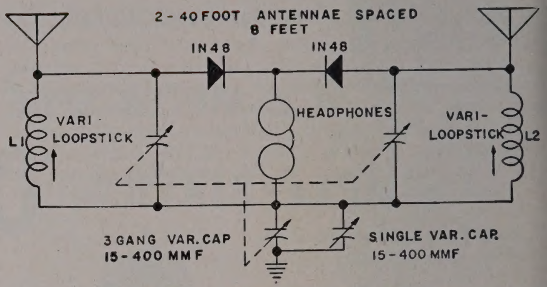
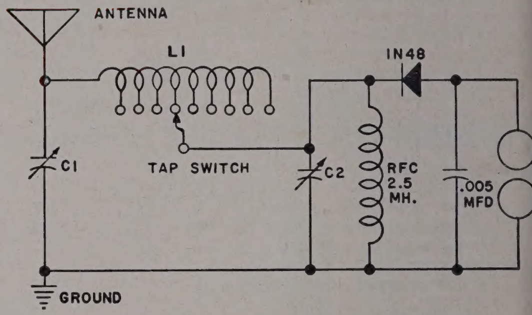
Sweeping the Spectrum . . . . . page 7
1955 Edison Radio Amateur Award . . . . . page 8

OPERATION CRYSTAL

The idea for this twin crystal receiver, which uses two of everything except grounds and pairs of earphones, came from Edmon L. Anderson, Moorpark, California. The three-gang 15–400-mmf broadcast band type variable capacitor, shown at right, tunes both detector circuits and the series-tuned ground circuit. A single variable air or mica-padding capacitor helps make the ground circuit tuning track. After a station is tuned in, some interesting variations in carrier and audio signal strength can be obtained by tuning the slugs in Vari-loopstick coils L_1 and L_2. A definite reduction in signal strength was noted when one crystal diode was disconnected after first peaking all the adjustments for maximum signal with both parts of the circuit working. If you try this test, do not expect to detect any startling differences by ear. In making these tests, I find that an oscilloscope used as a peak-to-peak audio voltmeter and the low voltage ranges on a vacuum tube voltmeter are necessary to evaluate the merit of most circuits. Erecting the extra antenna 8 feet from my original test antenna was a simple task because Mother Nature correctly placed the necessary trees at the test location.

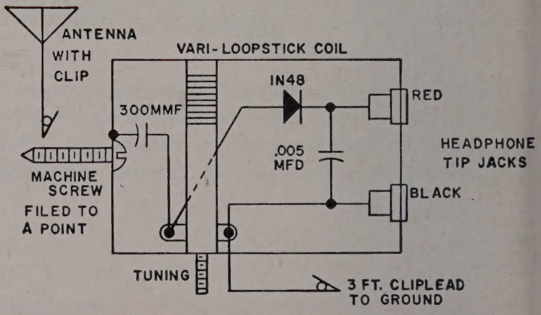

2 - 40 FOOT ANTENNAE SPACED 8 FEET
IN48
IN48
L1
VARI LOOPSTICK
HEADPHONES
VARI-LOOPSTICK
L2
3 GANG VAR. CAP 15-400 MMF
SINGLE VAR. CAP 15-400 MMF

Pi-networks are getting into the act in every corner of amateur radio these days! If you haven't thrown away those old 3- or 4-gang broadcast set variable capacitors that probably have been kicking around in your junk-box for several years, stick them into this Canadian pi-network crystal receiver dreamed up by E. J. Epp, VE3AJY, of Armstrong, Ontario. A single-gang capacitor with a few 500-mmf fixed capacitors that can be switched across it with a tap switch also will work for both C_1 and C_2, pictured at the right. If you have plenty of No. 30 wire, tap switches and ambition, you can build your own coil by winding 180 turns, tapped every 10th turn, on a 1¼-inch diameter form. Or, substituting a Vari-loopstick coil will give you just about the same results, but look at all the fun you will miss by not winding and tapping those 180 turns. Both audio voltage and direct current through the headphones were somewhat higher than with a conventional tuned circuit because of an improved impedance match at both ends of the pi-network when properly adjusted.



Here's an idea, also pictured at the right, for making a combination signal tracer and crystal radio receiver, submitted by J. L. Walty, of Walla Walla, Washington. The circuit is built into a small plastic box about 3 x 2 x 1 inches, with a probe on one end made from a 1½-inch long brass machine screw.

If your pet crystal receiver circuit can be squeezed into a small box, use it instead of Mr. Walty's simple one using just a slug-tuned Vari-loopstick coil. The 300-mmf coupling capacitor from the probe to the coil is necessary to keep DC voltages out of the circuit when tracing a plate circuit signal. The ground clip lead should be connected to the chassis when signal tracing, or an earth ground for crystal receiver operation. An outside antenna should be hooked on the probe when using this gadget as a radio.



All ideas submitted before December 1, 1955, will be eligible for publication in the OPERATION CRYSTAL Column. (See G-E HAM NEWS, Volume 10, No. 1, for details.) Do not send in your model!! Submitters of the three ideas published in each issue receive certificates for $10 in G-E electronic tubes. Construction and simple antenna hints of an outstanding nature are also eligible. All material submitted must be free of patent restrictions and becomes the property of G-E HAM NEWS.

—*Danny Diode*

"SIMPLE-SIXER" CONVERTER

Here's a 6-meter crystal-controlled converter designed especially for the radio amateur who has *tasted* this band with the *bare essentials* and is now ready for equipment that will enable him to explore the interesting possibilities of the 50- to 54-megacycle range to the fullest extent.

Why use a cascode circuit on 6 meters? The lower noise figure of this type circuit over conventional pentode RF amplifiers will not be noticed at many locations at which the local noise level is high. But, local noise may be substantially lower during those early daylight or late evening hours when tropospheric-bending propagation is often present. That last 2 or 3 db reduction of internal noise in this converter will help you complete many extended ground wave contacts during those periods.

The stability problem encountered in using a converter with a tunable oscillator for this band is easily licked by using the fifth overtone of an 8-megacycle crystal to provide a 40-megacycle mixing signal without resorting to frequency multipliers after the oscillator. The resulting 10- to 14-megacycle intermediate frequency range was selected after surveying the tuning ranges of most popular communications receivers. BC-348 and SX-96 receiver owners will find that crystal oscillator output frequencies of 40.5 and 41 megacycles respectively, will allow the 6-meter band to be covered in one tuning range.

The electrical bandspread tuning dial on receivers having them can be juggled to make the main tuning dial read the correct tuning range if you wish to use a crystal not precisely 8 megacycles.

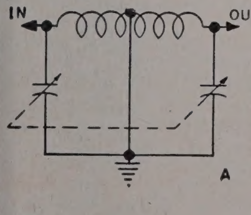
Performance requirements for the receiver into which the converter works can best be described by the old saying, "The merit of a radio receiver is not in what it will receive, but in what it will not receive." If your receiver is sufficiently well shielded to be almost "dead" in this range with the antenna and ground disconnected, you are already in business.

Replacing the receiver antenna terminal strip with a coaxial cable jack will reduce unwanted signal pickup from this source in many cases. Or, the jack could be mounted on a small aluminum box that encloses the antenna terminals if you do not wish to alter your receiver. (If you solve the problem of tightening the antenna terminal screw when the box is in place, send in a description to our "Tricks and Topics" column.)

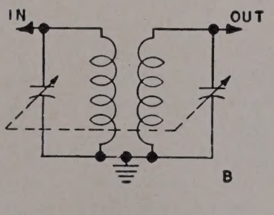
CIRCUIT DETAILS

The antenna input impedance matching arrangement shown in the schematic diagram, Fig. 1, also used in the G-E HAM NEWS "R-9'er" (See Volume 1 No. 4, for details), simplifies adjustment of the antenna coupling to the RF amplifier input circuit (L_1–C_1).

The double-tuned tank circuit shown below at "A" is actually the equivalent of circuit "B." These units are easily made from a single, tapped length of B & W *Miniductor* coil material with the ends connected to the stator sections of a *Johnson type M* midget butterfly variable capacitor. The two units used in the RF amplifier grid (L_1–C_1) and plate (L_2–C_2) circuits were stagger-tuned to provide a flat-topped response curve about 4 megacycles wide when the converter was checked with standard television receiver RF alignment equipment. These tank circuits also have good *skirt* selectivity, which helps prevent strong signals in the 10- to 14-megacycle intermediate frequency range from feeding through the converter.



A



B

The simplified cascode RF amplifier circuit using a 6BK7A gives about the same rejection to a 10-megacycle test signal fed into antenna jack J_1 as a more complicated circuit using an extra tuned circuit between the two cascode tube sections. Use of shields on all tubes also helps prevent direct intermediate frequency signal pickup.

The pentode half of a 6U8 works as a mixer, with the triode functioning as an overtone crystal oscillator. The pi-network (L_4, C_4, C_5) feedback arrangement allows considerable flexibility in crystal choice. Inexpensive third-overtone 24-megacycle or most 8 megacycle fundamental frequency crystals have satisfactory output at the 40-megacycle fifth overtone, avoiding the need for the more costly VHF crystals.

Another 6U8 pentode section intermediate frequency amplifier feeds the triode section, used as a cathode follower output stage. The two intermediate frequency plate circuit coils (L_5 and L_6) are stagger-tuned for improved band-pass in the 10- to 14-megacycle range. Some inexpensive receivers which may be used as the tunable intermediate frequency section have no RF amplifier. The intermediate frequency amplifier built into the converter insures sufficient gain to overcome this limitation. A gain control which varies the cathode bias on this stage permits the converter output to be adjusted for best performance without overloading even "hot" receivers. Heater and plate power can be obtained from any source capable of supplying 6.3 volts at 1.2 amperes and 200–250 volts DC at 40 milliamperes.

CONSTRUCTION

The difficult task of working in the tight corners of a small conventional chassis was avoided by building the converter on the half of a 3 x 5 x 7-inch aluminum "channel-lock" type two-piece utility case having the 3- x 5-inch ends. The parts layout was determined after much *cut-and-try* and should be followed closely. The padder capacitor, coil forms, tube and crystal sockets and terminal strips mount on the top of this box in the locations marked on the chassis drilling diagram, Fig. 2. The gain control and antenna input coaxial cable jack (J_1) are located on one end plate $1\frac{1}{2}$ inches down from the top and $1\frac{1}{4}$ inches in from the side corners. The output jack (J_2) and a 3-screw terminal connection strip occupy the other end.

A small shield made from $\frac{1}{32}$-inch thick soft sheet aluminum $4\frac{3}{4}$ x $3\frac{1}{8}$ inches separates L_5, L_6, J_2 and the intermediate frequency amplifier tube socket from the VHF circuits. The metal is folded so that the long side is 2 inches long, the short wall $1\frac{1}{2}$ inches wide, with a $1\frac{1}{4}$-inch long wall placed at an angle between them. Two small $\frac{1}{4}$-inch wide flanges are formed on the side adjacent to the top of the chassis for mounting with 4–40 x $\frac{1}{4}$-inch long machine screws, as shown in the bottom view, Fig. 3. The shield should be trimmed to fit snugly against the other half of the utility case when it is assembled. The top corner at each end of the shield is cut off to permit wiring to enter the intermediate frequency compartment.

The shield should be mounted after all connections except the wire from plate pin 6 of the 6U8 mixer tube socket to the lower end of L_5 are completed. This lead passes through a $\frac{1}{4}$-inch diameter hole in the

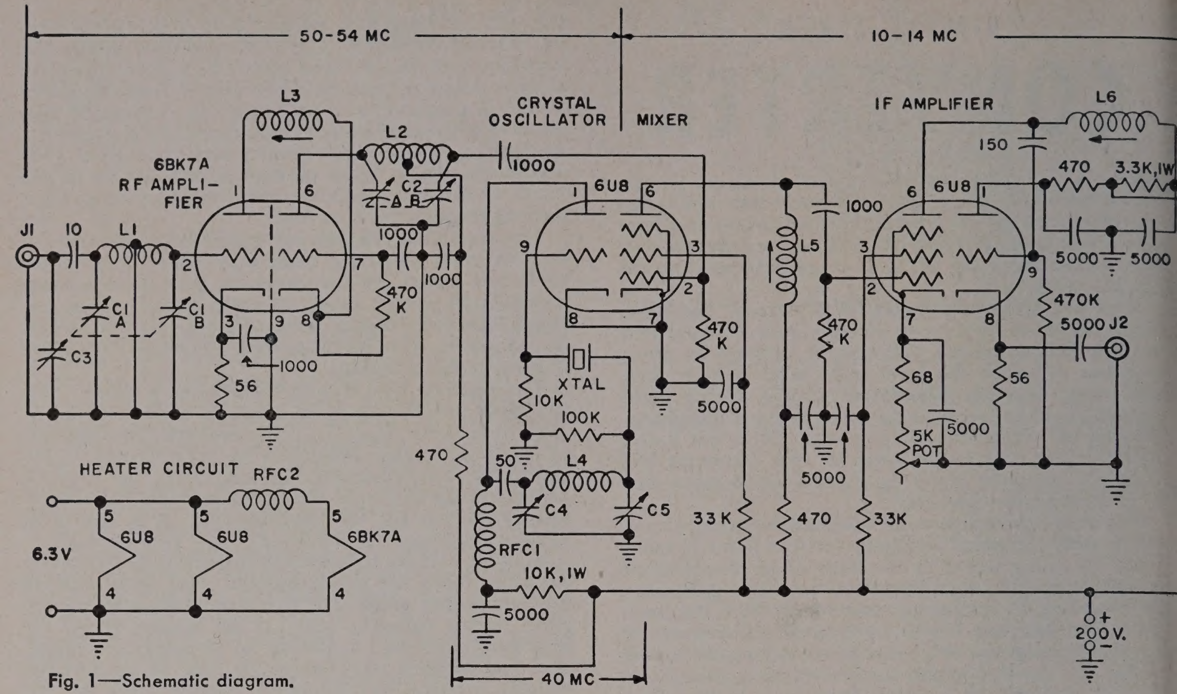

50-54 MC
10-14 MC
L3
L2
CRYSTAL OSCILLATOR
MIXER
IF AMPLIFIER
L6
6BK7A RF AMPLI-FIER
C2 A B
1000
6U8
150
470
3.3K,1W
J1
10
L1
C1 A
C1 B
C3
470 K
1000
9
3
2
L5
470 K
5000
5000
470K
5000 J2
56
1000
XTAL
10K
100K
68
5000
5K POT
HEATER CIRCUIT
RFC2
470
50
L4
C4
C5
33 K
470
33K
6.3V
6U8
6U8
6BK7A
RFC1
10K, 1W
5000
+ 200 V. −
40 MC

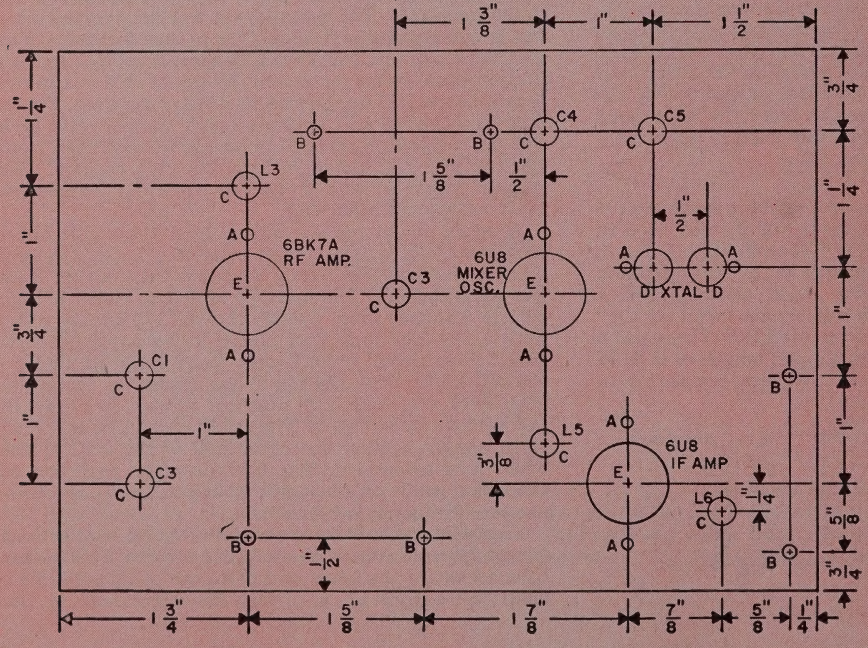
Fig. 1—Schematic diagram.

PARTS LIST

C_1, C_2,—2.2–8.0-mmf butterfly variable capacitors (Johnson 9MB11 Cat. 160–208)
C_3, C_5,—15–130-mmf variable mica padder capacitor (El Menco 302)
C_4—1.8–8.7-mmf single midget variable capacitor (Johnson 9M11 Cat. 160–104)
RFC_1, RFC_2—Ohmite Z-50 RF Chokes
Xtal-Quartz crystal, 8.000 or 24.000 megacycles
All capacitors in mmf, 600-volt disc ceramic
All resistors ½-watt, unless otherwise specified

COIL TABLE

L_1, L_2 and L_4 made from B & W Miniductors, Type 3007, ⅝-inch diameter, 16 turns per inch
L_1—9 turns with ¾-inch leads, tapped at 4 turns from antenna end
L_2—10 turns with ¾-inch leads, center-tapped
L_3—CTC Type LS-3 blank coil form close-wound with 20 turns of No. 26 enameled wire
L_4—14 turns with ½-inch leads
L_5, L_6—CTC Type LS-3 10-megacycle coils, as-is (Cambridge Thermionic Corp.)


1 3/8"
1"
1 1/2"
3/4"
1 1/4"
1"
3/4"
1"
B
B
C4
C5
C
C
1 5/8"
1/2"
1/2"
1 1/4"
1"
L3
C
A
A
A
A
6BK7A RF AMP.
6U8 MIXER OSC.
C3
C
E
E
D XTAL D
C1
C
1"
C3
C
A
A
B
L5
C
3/8
6U8 IF AMP
E
L6
C
1/4"
5/8"
B
B
1/2"
B
B
3/4"
1 3/4"
1 5/8"
1 7/8"
7/8"
5/8"
1/4"

DRILL LEGEND

"A" drill—No. 32 spaced to suit sockets

"B" drill—No. 26 for terminal strips

"C" drill—¼-inch diameter

"D" drill—⅜-inch diameter for crystal socket

"E" socket punch—¾-inch diameter

Fig. 2—Drilling diagram of the 6-meter converter.

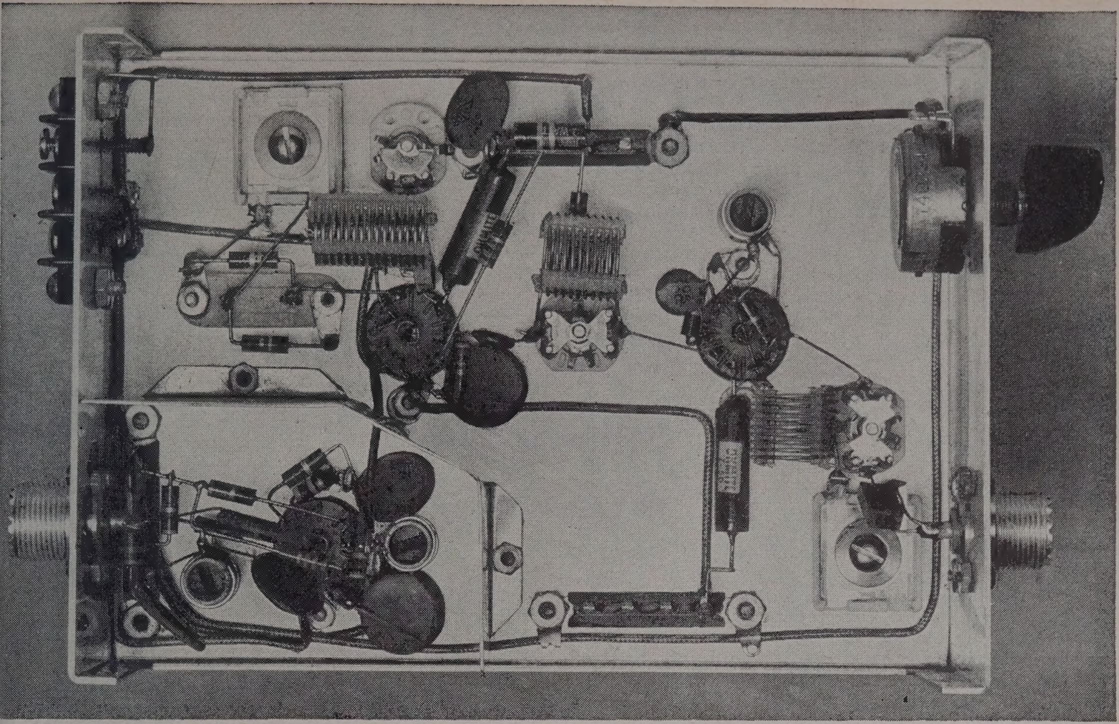


Fig. 3—Bottom view of the 6-meter converter showing placement of the shield around the intermediate frequency amplifier and positioning of coils.

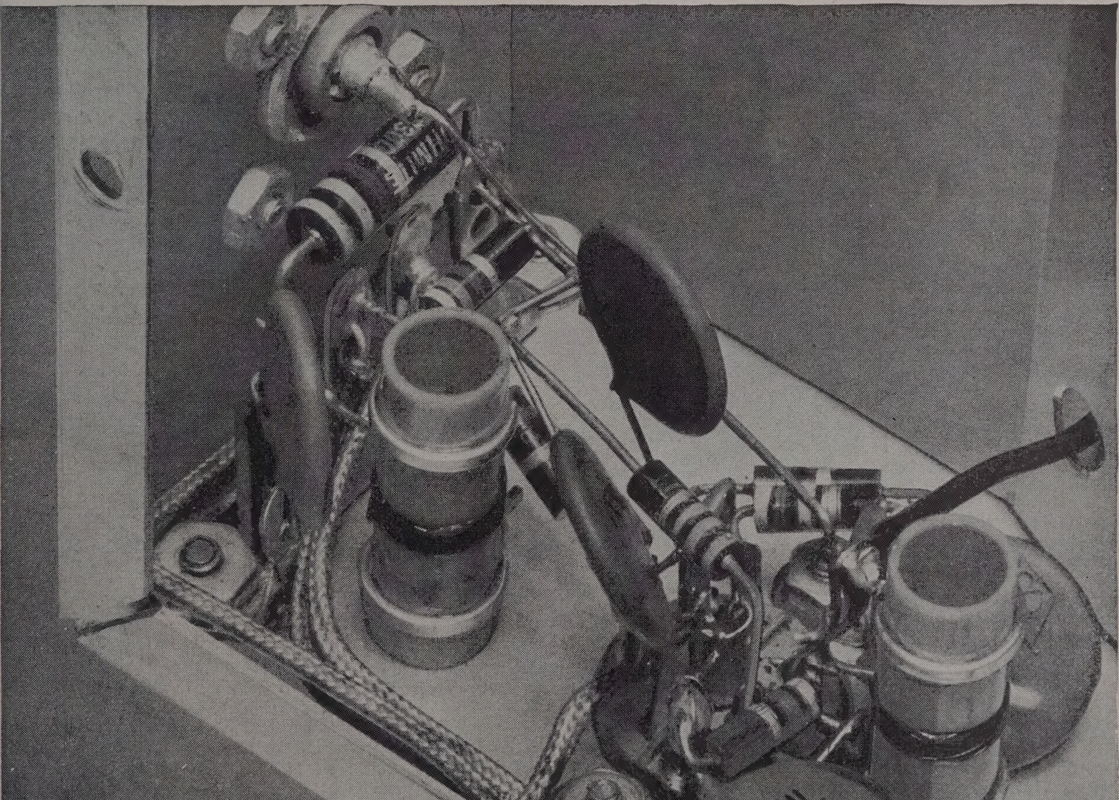


Fig. 4—Intermediate frequency amplifier compartment view.

shield, pictured in the compartment view, Fig. 4. The soldering terminals on L_5 and L_6 should not be moved when assembling and wiring these coils or the fine wire leads may be damaged.

All resistors except the cathode bias and grid-to-ground units mount on the three 4-terminal Cinch-Jones 2000–4 mounting strips placed at convenient locations. By-pass and coupling capacitors fasten directly on their associated parts and to ground terminal lugs placed under all the 4–40 x ¼-inch long machine screws holding the tube sockets, coaxial cable connectors and terminal strips to the chassis.

All heater, plate power and gain control connecting leads run near the corners of the chassis. However, keep these wires and all other parts at least ⅛-inch away from these corners so that the other half of the case can be assembled without interference.

Duplication of band-pass transformers L_1–C_1 and L_2–C_2 is simplified by making the coils from standard Miniductor material and using the midget butterfly variable capacitors for fine tuning adjustments. The coil used for L_2 should be tapped as shown in the coil table on page 4 by bending in the coil-turn each side of the tap enough to prevent it from becoming shorted when one lead from the 1000-mmf ceramic disk by-pass capacitor is soldered to the proper coil-turn. One lead of a 470-ohm resistor also connects to this coil-tap. The other end of this resistor extends to the plate voltage lug on the nearest terminal strip. The other by-pass capacitor lead connects directly to the rotor ground lug on C_2. The ends of the coil then connect to the stator lugs on C_2 with leads just long enough to allow the coil to clear the capacitor rotor when it is tuned. The completed transformer assembly is pictured in Fig. 5.

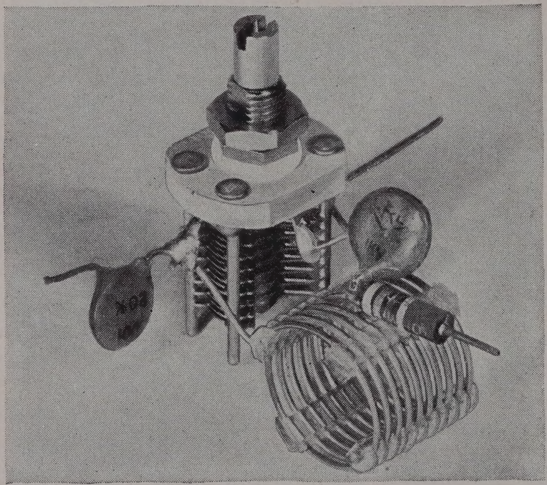


Fig. 5—Detail view of RF transformer L_2–C_2. L_1–C_1 is identical except that no resistor and by-pass capacitor is used on the coil-tap.

Transformer C_1–L_1 is assembled in the same manner, except that a short length of wire is attached to the coil-tap for a direct ground connection to the rotor lug on C_1. Make sure the coils have no shorted turns before mounting the completed assemblies on the chassis. One stator lug on C_2 connects to plate pin 6 on the 6BK7A, the other lug goes to pin 2 of the 6U8 mixer through a 1000-mmf coupling capacitor. Corresponding lugs on C_1 connect to pin 2 on the 6BK7A and through a 10-mmf coupling capacitor to the ungrounded lug on C_3. All RF and by-pass connections should be made with shortest possible wires.

ADJUSTMENT PROCEDURE

Power should be applied to the converter and the heater voltage measured before inserting the 6U8 mixer-oscillator tube. Next, a tube shield is placed over the 6U8 and an appropriate crystal plugged into the proper socket. With C_5 set about one turn from maximum capacity, plate voltage is next applied. A No. 48 or 49 (2.0 volt, 60 ma) pilot bulb with a 1-inch diameter wire loop soldered to the base terminals or a small neon bulb, is then held near L_4, and C_4 is slowly tuned near maximum capacity until the bulb lights. Feedback capacitor C_5 should then slowly be turned toward maximum capacity until oscillation stops, then toward minimum capacity until oscillation again begins.

The oscillator frequency should next be checked with a calibrated wavemeter or receiver tuning the 40-megacycle range to insure that the oscillator is working on the correct overtone. Settings of C_5 will be near maximum capacity for overtone crystals and about one turn from maximum for fundamental crystals. Self-oscillation may be noted near the minimum capacity setting of C_4 when too much feedback is used.

The output of the converter is now connected to the station receiver through a length of coaxial cable and the 6U8 intermediate frequency amplifier tube and shield inserted. A signal generator or grid-dip oscillator covering both the 50 to 54 and 10- to 14-megacycle ranges is handy for aligning the remaining tuned circuits. Once the converter crystal oscillator is working, the station receiver can be used to check the calibration on both ranges of these instruments. L_5 and L_6 should be peaked at 11 and 13 megacycles respectively, using a signal fed into pin 2 of the 6U8 mixer.

The bottom half of the box should now be assembled and the 6BK7A tube and shield inserted. A short length of 52-ohm coaxial cable is then plugged into the antenna connector and a 56-ohm composition resistor wired across the other end. The signal source coupled to this cable is then set to 52.5 megacycles and C_2 is tuned for maximum signal.

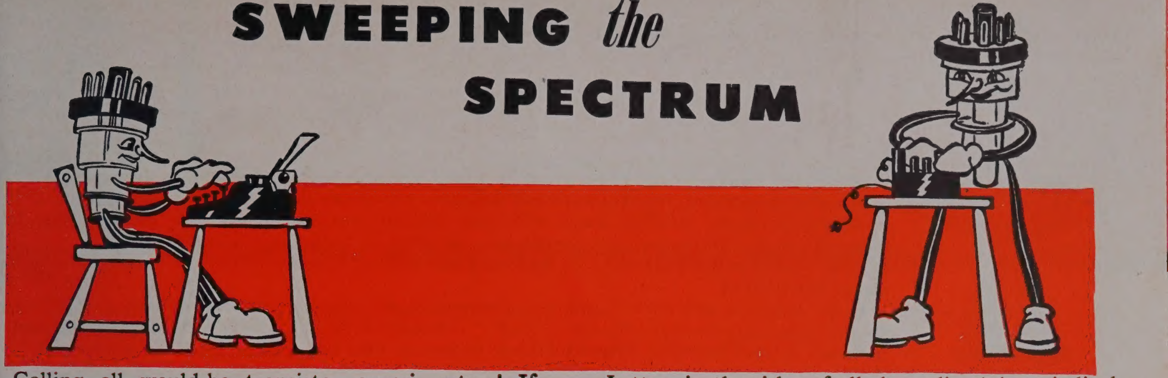
The antenna input circuit, L_1–C_1, antenna matching capacitor C_3 and neutralizing coil L_3 can next be adjusted for lowest noise figure using a noise generator, such as the one described on page 2 of the September–October, 1954, issue of G-E HAM NEWS. If a noise generator is not available, C_1 is adjusted for maximum signal when the test source is set at 50.5 megacycles.

Then, L_3 can be adjusted for *minimum* signal feed-through by temporarily disconnecting heater voltage from the 6BK7A. Adjustment of L_3 for best noise figure and the signal null is fairly broad at 50 megacycles. The heater power lead is again connected to the 6BK7A and C_3 is set for maximum signal at 50.5 megacycles. C_1 may need a slight readjustment for maximum response after matching the antenna impedance. A noise figure reading of 4 db was obtained on the test model on a laboratory-type noise generator using both the above alignment methods.

A shielded power connection cable will minimize intermediate frequency range signal pickup from this source. When an unshielded cable was used during tests, nearby short-wave broadcast stations in the 11.8-megacycle band were distinctly audible until a 1-mh RF choke was inserted in the positive plate lead *outside* the converter case at the terminal strip.

Best reception can only be obtained if an efficient antenna is used. A large rotary beam, such as a 2 or 3 bay stack of 4 or 5 element Yagi antennas, pays big dividends on the 50-megacycle band. They can be mounted on a few television antenna mast sections and braced with guy wires connected to a rotating guy ring placed just below the top bay. Each bay can be made from a "stretched" bargain-priced channel 2 television antenna.

SWEEPING *the* SPECTRUM



Calling all would-be transistor experimenters! If price has prevented you from trying some of the audio and low-frequency RF transistor circuits recently pubished, the Semi-conductor department of the G-E Electronics Division has come to your rescue with a new, inexpensive PNP junction transistor, the 2N107. They are now available on a display card at most G-E lectronic tube distributors in a convenient package of wo. Included in the package, which sells for little more than a carton of cigarettes, is a booklet showing everal simple audio voltage amplifier, speaker output amplifier, code-practice oscillator, radio receiver and TV antenna orientation meter circuits. They require only a few parts, plus two to four ordinary flashlight ells for power. Use them for a microphone preamplifier which will have no hum problems from AC tube heaters. They will operate in RF applications up to one megacycle. Try a package soon.

⁂

Remember the flood of comments and ideas I received or the Tricks and Topics Column four or five years ago about the "How to get the nut on the almost inaccessible bolt trick?" A ***king-sized*** example of a imilar situation recently came to my attention in the Camera Tube section of the G-E Power Tube factory here at Schenectady.

In the assembly of the GL-5820 image-orthicon type elevision camera tube, the ***target*** assembly must be owered through the neck to its final position near the aceplate with the tube standing on end. Then, small clamping screws must be carefully tightened, using screwdrivers 18 inches long, without having any dust enter the tube during this operation.

Delicacy of this assembly can be emphasized by the act that the target consists of a 0.00015-inch thick circle of glass separated 0.002 inches from a 500 wire-per-inch circular copper screen mesh by a spacer ring. Tiny rivets fasten the mesh to the spacer. One slip of a screwdriver and this microscopically thin glass circle hatters into tiny fragments that cannot be removed rom the tube. This is only one of many precision operations necessary to assemble the 256 parts of a ube that engineers throughout the tube industry heartily agree is about the most difficult to manufacture.

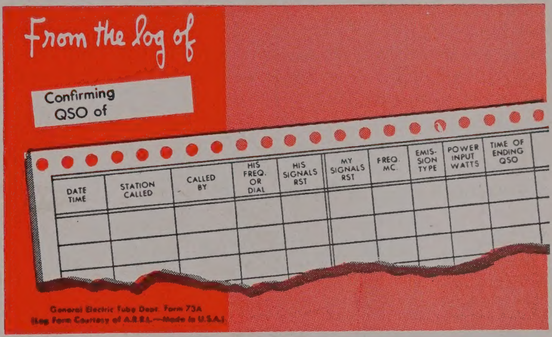
⁂

Supply of the first bound volume of G-E HAM NEWS, which contained all issues from Volume 1, No. to Volume 5, No. 6, has been exhausted. A second bound volume, which will contain all issues from Volume 6, No. 1, to Volume 10, No. 6, will be pubished during 1956. Over two hundred people have already asked to be placed on the list reserving a copy or them. If you would like to be notified when this econd bound volume will be available, send in your name and mailing address, but please do ***not*** make any remittance at this time.

Letters in the titles of all the radio club periodicals and bulletins regularly received at the G-E HAM NEWS office would make a good-sized pot of alphabet soup. After browsing through a stack that the editor passed on to me, I notice that "SPARKS" and "NEWS," preceded by the name of the club, seem to be the most popular titles, by far. Some of the more enterprising papers even run a cross-word puzzle!

Seriously, receipt of all these publications enables me to get a pretty good idea of just what is going on, activity-wise, in the far-flung areas of ham-dom. Keep sending them in, fellows!!

⁂



From the log of

Confirming
QSO of

DATE TIME	STATION CALLED	CALLED BY	HIS FREQ. OR DIAL	HIS SIGNALS RST	MY SIGNALS RST	FREQ. MC.	EMISSION TYPE	POWER INPUT WATTS	TIME OF ENDING QSO

General Electric Tube Dept. Form 73A
(Log Form Courtesy of A.R.R.L.—Made in U.S.A.)

Response to my request for opinions on how you liked the idea for the G-E HAM NEWS QSL card (shown above again just in case you missed the picture of it in the last issue) has been terrific. Your answers rolled in by letter, postcard, QSL card and radiogram saying—overwhelmingly . . . YES!! Consequently, packages of 300 QSL cards now are available, for only one dollar, delivered postpaid to your door. We have had the printer wrap them, ready to ship, in packages of 300. Please order them in that quantity, or multiples of it. At this price, we cannot accept orders requesting C.O.D. shipment or billing at a later date. Kindly enclose full remittance with your order.

Radio amateurs in the United States, Canada, Alaska, Hawaii and the Panama Canal Zone should make checks or money orders payable to: Tube Department, General Electric Company, Schenectady 5, New York. In all other countries, write: Lighthouse Larry, International General Electric Company, 570 Lexington Avenue, New York 22, New York.

Several short-wave listeners also voted for these QSL cards, adding another idea to the list of suggested uses we printed in the last issue. Note that there is plenty of space above and below the log form for your call letters, address and remarks. To all those who expressed interest in this project by sending in their comments—A MILLION THANKS!!

—*Lighthouse Larry*

NOMINATIONS NOW OPEN FOR 1955 EDISON AWARD

The Fourth Annual Edison Radio Amateur Award will give you an opportunity to recommend for high honors an amateur who has rendered important public service.

Handsome trophy, a $500 check, and coast-to-coast recognition await the 1955 winner. The panel of judges will consider only candidates nominated by letters from you and others.

Start now to make your selection and assemble the facts for your nominating letter. Read the Award Rules below

Radio Amateurs and their friends are generous in acclaiming accomplishment. No better means for this exists than for you to name . . soon . . a candidate for the Edison Award. Send your letter to Edison Award Committee, General Electric Company, Tube Department, Schenectady 5, N. Y.

RULES OF THE AWARD

WHO IS ELIGIBLE. Any man or woman holding a radio amateur's license issued by the F.C.C., Washington, D.C., who in 1955 performed a meritorious public service in behalf of an individual or group. The service must have been performed while the candidate was pursuing his hobby as an amateur within the continental limits of the United States.

WINNER OF THE AWARD will receive the Edison trophy in a public ceremony in a centrally located metropolitan city. Expenses of his trip to that city will be paid.

$500 GIFT. Winner will be presented with a check for this amount in recognition of the public service he has rendered.

WHO CAN NOMINATE. Any individual, club or association familiar with the service performed.

HOW TO NOMINATE. Include in a letter the candidate's name, address, call letters, and a full description of the service performed. Your letter must be postmarked not later than January 2, 1956.

BASIS FOR JUDGING. All entries will be reviewed by a group of distinguished and impartial judges. Their decisions will be based on (1) the greatest benefit to an individual or group (2) the amount of ingenuity and sacrifice displayed in performing the service.

JUDGES WILL BE

E. ROLAND HARRIMAN, President, The American Red Cross.

HERBERT HOOVER, JR., the Under Secretary, U.S. Department of State.

EDWARD M. WEBSTER, Commissioner, Federal Communications Commission.

GOODWIN L. DOSLAND, President, American Radio Relay League.

Winner of the Award will be announced on or before Thomas A. Edison's birthday, February 11, 1956.

Employees of the General Electric Company may nominate candidates for the Edison Radio Amateur Award, but are not permitted to receive the Award.

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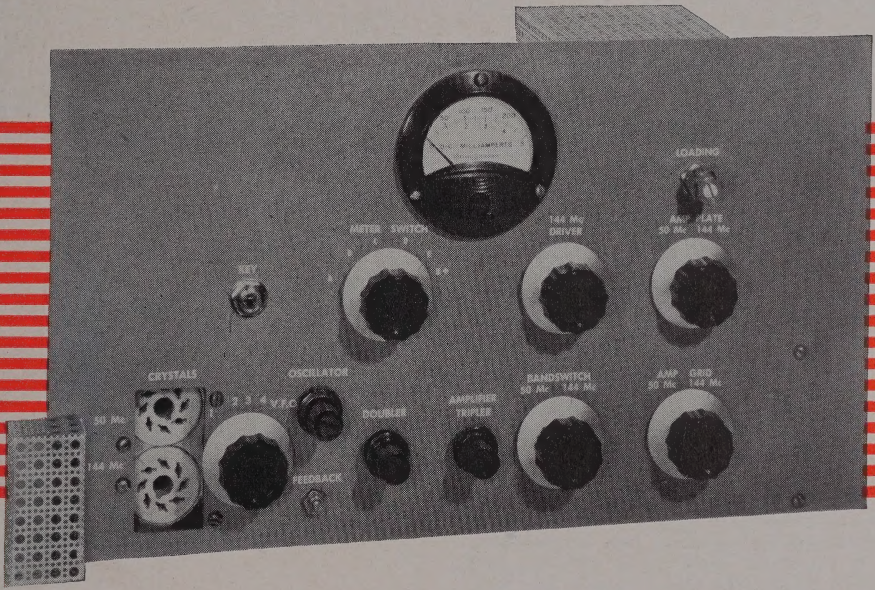
NOVEMBER–DECEMBER, 1955 VOL. 10—NO. 6

A 6-METER SPECTACULAR—Part III

"BONUS 100-WATT" TRANSMITTER


LOADING
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OSCILLATOR
V.F.O.
DOUBLER
AMPLIFIER TRIPLER
BANDSWITCH 50 Mc 144 Mc
AMP GRID 50 Mc 144 Mc
FEEDBACK

Almost any dictionary will tell you that the word "BONUS" means, "Something given in addition to what is usual." By employing an extra tube, plus a few dual-range tank circuits and parts, this "Bonus 100-watt Transmitter," developed by W2ZHI for Part III of the G-E HAM NEWS 6-meter Spectacular, also puts you on 2 meters with the same power. Front panel controls for all normal tuning, circuit metering, crystal changing and switching, permit this rig to be buttoned up in a complete TVI shield if necessary.

—*Lighthouse Larry*

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Sweeping the Spectrum . . . . page 7
"Operation Crystal" . . . . page 8

BONUS 100-WATT TRANSMITTER

Most amateur transmitters for 50 or 144 megacycles follow the same frequency range pattern in the first stages of the exciter. Why build two separate units, practically identical, when one exciter can handle both jobs?

And while we're at it, why not design the final amplifier to cover both bands? Of course, the amplifier tube selected would have to be one which works efficiently on the 144-megacycle band, such as the GL-829B. This tube can be run from relatively inexpensive power supplies and plate modulators. Several commercially built 3.5- to 30-megacycle amateur transmitters are marketed in this 100-watt power class. If you are the owner of one of these rigs, you can *borrow* plate and modulation power from it for this "Bonus 100-watt Transmitter." This unit also makes a good exciter for that future one-kilowatt amplifier to help extend your VHF working range after you have installed a rotary beam antenna and a low noise receiver for each band.

CIRCUIT DETAILS

After glancing at the schematic circuit diagram, shown in Fig. 1, you may think that Lighthouse Larry has fallen into a rut by using this pi-network overtone crystal oscillator circuit for the third time in as many issues. But—that's no rut—that's just a good versatile oscillator circuit. One half of a 12AT7 twin-triode oscillates from 24 to 27 megacycles by tuning C_1. Mica padder capacitor C_2 controls the feedback to any one of four 8.000 to 8.222 or 8.334 to 9.000 megacycle crystals. This permits your local network or calling frequency and one other frequency to be covered in each band. The fifth position on crystal selector switch S_1 permits output from an external 8- or 12-megacycle variable frequency oscillator connected to J_1 to be fed into the grid of the oscillator tube, which then operates as a tripler or doubler, respectively.

Tank circuit L_2-C_3 in the plate circuit of the other section of the 12AT7 doubles frequency to the 48–54-megacycle range. A two-band pi-network circuit appears in the plate circuit of the 5763 amplifier-tripler stage. On 144 megacycles, bandswitch S_2 (shown in the 144-megacycle position) connects the output side of coil L_3 to loading capacitor C_7 in the grid circuit of the GL-2E26 144-megacycle amplifier. When S_2 is placed in the 50-megacycle position, L_4 is placed in series with L_3 and loading capacitor C_6 matches the output of this larger pi-network to the amplifier link coaxial cable. This circuit is tuned on both bands with C_4. Mica padder capacitor C_5 and the lead to screen grid pin 6 on the 5763 tube socket form a series-resonant circuit to stabilize this stage when working it as a 50-megacycle amplifier.

A series-tuned 144-megacycle tank circuit in the plate circuit of the GL-2E26 consists of C_9 and L_5. To insure stability, variable capacitor C_8 and its connecting leads provide a series-tuned screen grid neutralization circuit for this stage. This tube is disabled by removing screen voltage and grid excitation when S_2 is in the 50-megacycle position. The bandswitch also increases the grid circuit resistance of the 5763 tripler stage in the 144-megacycle position and transfers the RG-58/U coaxial cable from link L_8 in the grid circuit of the GL-829B amplifier to either the 50-megacycle output from the 5763 or the 144-megacycle output from L_6 in the plate circuit of the GL-2E26 stage. Enough cathode bias is used on these stages to keep the plate dissipation within bounds when no excitation is present.

The problem of working the GL-829B stage on both 50 and 144 megacycles without bandswitches or plug-in coils was solved by using capacity-loaded half-wavelength linear grid and plate tank circuits for 144 megacycles (L_9 and L_{12}). Then, small split coils (L_7 and L_{10}) were tapped onto the lines at the 144-megacycle RF ground point. The inductance of these coils was adjusted to resonate at 50 megacycles with the tube, circuit and tuning capacities. The rotor of plate circuit butterfly variable capacitor C_{11} is not grounded. Otherwise, the 0.030-inch air-gap with which this capacitor is supplied would not be sufficient to withstand positive plate modulation peaks with a 600-volt amplifier plate supply. Variable link coil L_{11} couples the transmitter output to a 50-ohm coaxial cable. A larger coil will be required if the transmitter feeds a 300-ohm line.

A combination clamp-tube and keying circuit in the screen of the GL-829B is formed by the 6V6-GT and OB2 tubes. When the GL-829B is drawing grid current, the 6V6-GT is biased to cut-off and screen current flows through the OB2. Lack of amplifier grid current because of no driving power or removing the grid bias from the 6V6-GT by opening keying circuit jack J_3 permits this tube to draw plate current.

The extra voltage drop through the 20,000-ohm adjustable screen resistor causes the OB2 voltage regulator tube to stop conducting. The GL-829B screen voltage then falls to zero, reducing the plate current to a very low value.

METERING CIRCUITS

In positions A to E, a 2-pole, 6-position rotary tap switch (S_3) connects a 0- to 1-milliammeter in series with a 2000-ohm resistor across shunting resistors placed in series with circuits where current metering is desired. This range meter now costs no more than those with larger current ratings and simplifies the selection of shunting resistors. The 400-ohm shunts in positions A and B provide a 5-milliampere full scale reading for the 5763 and GL-2E26 grid currents. Position C measures up to 100 milliamperes full scale across the 20-ohm resistor in the GL-2E26 plate circuit. The GL-829B grid current is read in position D across a 100-ohm resistor. Two 16-ohm, 1-watt resistors in parallel provide a full scale meter reading of 250 milliamperes in the GL-829B plate circuit in position E.

In the sixth position F, the meter is placed in series with two 390,000-ohm, ½-watt resistors for measuring the amplifier plate supply up to 800 volts. This position could be changed to place the meter across a 20-ohm resistor in the 5763 plate supply lead to provide a 100-milliampere full scale reading, if desired.

MECHANICAL DETAILS

The entire RF unit is mounted on an 8 x 12 x 3-inch deep aluminum chassis, drilled as shown in Fig. 2. The 8 x 14-inch cabinet panel and chassis front are drilled with matching holes. Location of most critical parts is marked on this illustration. The tuning controls for the exciter were mounted along the front edge of the chassis. Space was left at the right side for the GL-829B amplifier and associated tank circuits. The special septar socket (Johnson 122-101) used for this tube has provision for crossed No. 12 plastic insulated neutralizing wires to run from the grid connections through small holes in the ceramic wafer. They extend up the sides of the tube, forming one plate of capacitors C_N, with the tube plates forming the other. The 2⅝-inch diameter hole for this socket was made with a circle cutter. Or, it can also be "nibbled" out with a pair of small tin shears if a *starter* hole is first made with a socket punch.

Amplifier plate tuning capacitor C_{11} mounts on a ¼-inch thick block of polystyrene or lucite 2 inches wide and 1¾ inches high. Three 6–32 x ½-inch deep oles are drilled and tapped in this insulator for mount-ng screws which run up through the chassis or it can e fastened to a small piece of aluminum angle. The horter lengths of copper tubing forming part of L$_{12}$ lie n notches cut in the upper corners of this insulator. right angle bend in the tubing permits the ends to onnect to the stator terminals on C$_{12}$. The other ends f this tubing fasten to 8–32 x 3¼-inch long threaded rass rods mounted on a pair of 1-inch high cone insu-ators. Lugs formed on the ends of 50-megacycle plate oil L$_{10}$ slip on the threaded rods and fasten with 8–32 rass hex nuts above and below them. This mounting llows L$_{10}$ to be positioned at the 144-megacycle RF round point on the tank circuit. The longer tubing n L$_{12}$ extends from the top of the threaded rods to the heat radiating plate caps on the GL-829B through ¾-inch long flexible strips made from 0.010-inch thick sheet copper flashing material. The metal-to-glass plate pin seals on the GL-829B may be cracked if the tubing is attached directly to the plate caps.

Output link coil L$_{11}$ fastens to the rear of a 3-inch long, ¼-inch diameter shaft and panel bearing assembly. A 6–32 x ⅜-inch deep hole is tapped in the end of the shaft for fastening the grounded side of the link. A shaft lock prevents the coupling from changing after adjustment. A box made from perforated sheet aluminum 3½ inches wide, 4½ inches high and 8 inches long encloses the amplifier plate circuit. Several 6–32 self-tapping screws fasten the shield to the back, top and side of the chassis. Inter-stage shielding made from

PARTS LIST

$_1$—2.7–19.6-mmf variable (Johnson 20M11)
$_{2,5,6}$—65–340-mmf mica padder (El Menco 303)
$_3$—2.3–14.2-mmf variable (Johnson 15M11)
$_4$—1.7–8.7-mmf variable (Johnson 9M11)
$_7$—5.0–50-mmf mica trimmer
$_8$—6–75-mmf variable (Johnson 75K10)
$_9$—2.8–11-mmf variable (Johnson 10L15)
$_{10}$—4.3–26-mmf butterfly variable (Johnson 25LB15)
$_{11}$—2.8–10.5-mmf butterfly variable (Johnson 10LB15)
$_{1, 2}$—chassis coaxial receptacle
J$_3$—3-conductor single closed circuit phone jack
RFC$_1$—1-mh, 100-ma (National R-50)
RFC$_{2, 6}$—7-uh choke (Ohmite Z-50)
RFC$_{3, 4, 5}$—0.84-uh choke (Ohmite Z-144)
S$_1$—1-pole, 5-position tap switch (Mallory 3215J)
S$_2$—6-pole, 2-position midget ceramic tap switch (Centralab PA-2019)
S$_3$—2-pole, 6-position tap switch (Mallory 3226J)
T$_1$—6.3-volt, 4.5 ampere filament transformer
All capacitors in mmf are 600-volt disk ceramic, capacitors in mfd are 600-volt paper.
All resistors ½-watt, ±10%, unless otherwise specified.

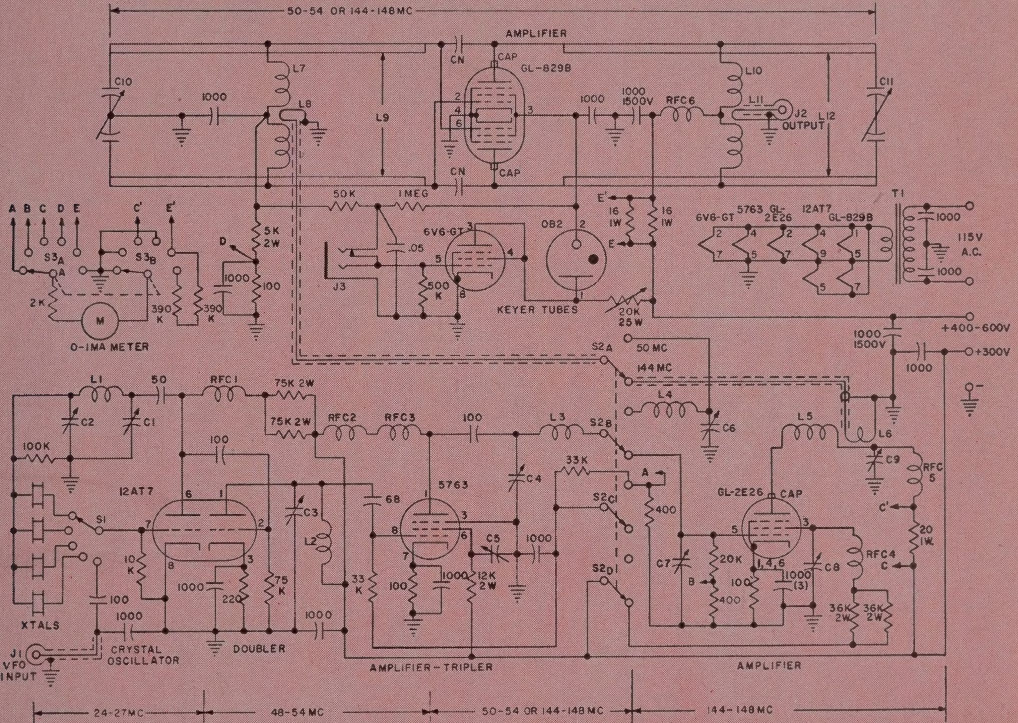

50-54 OR 144-148MC
AMPLIFIER
CN
CAP
GL-829B
C10
1000
L7
L8
L9
1000
1000 1500V
RFC6
L10
L11
J2 OUTPUT
L12
C11
50K
1MEG
A B C D E
C'
E'
S3A
S3B
2K
M
0-1MA METER
390 K
390 K
D
5K 2W
1000
100
6V6-GT
.05
500 K
J3
OB2
KEYER TUBES
20K 25W
16 1W
16 1W
6V6-GT
5763
GL-2E26
12AT7
GL-829B
T1
1000
115V A.C.
1000
+400-600V
1000 1500V
1000
+300V
S2A
50 MC
144 MC
L4
C6
L1
C2
C1
50
RFC1
75K 2W
75K 2W
RFC2
RFC3
100
L3
S2B
L5
L6
C9
RFC 5
100K
100
12AT7
S1
C3
L2
68
5763
C4
33K
A
S2C
400
GL-2E26
CAP
C'
20 1W
10 K
1000
22
75 K
33 K
100
1000
12K 2W
C5
1000
S2D
C7
20K
B
100
400
1,4,6
1000 (3)
C8
RFC4
C
36K 2W
36K 2W
XTALS
100
1000
1000
J1 VFO INPUT
CRYSTAL OSCILLATOR
DOUBLER
AMPLIFIER-TRIPLER
AMPLIFIER
24-27MC
48-54MC
50-54 OR 144-148MC
144-148MC

Fig. 1
matic diagram.

COIL TABLE

IOTE: Coils L$_1$, L$_2$ and L$_4$ made from B & W Miniductors, type 3007, ⅝-inch diameter, 16 turns per inch. L$_1$—15 turns, L$_2$ and L$_4$—5 turns.

$_3$—4 turns, No. 16 solid wire, ½-inch diameter, ⅝-inch long.

$_5$—4 turns, No. 12 solid wire, ½-inch diameter, ¾-inch long.

$_6$—1 turn loop, No. 12 plastic insulated solid wire, ½-inch diameter.

$_7$—1 turn loop, No. 12 solid wire, 1-inch diameter with ¾-inch leads.

$_8$—1 turn loop No. 12 plastic insulated solid wire, ¾-inch diameter, with a loop to fit a No. 8 screw on one end.

L$_9$—12-inch length of 300-ohm flat twinlead, tapped 4 inches from grid end by removing 1 inch of insulation and twisting the wires into ½-inch leads, ½-inch long leads formed at each end.

L$_{10}$—8 turns, No. 10 solid wire, ¾-inch diameter, formed into 2 4-turn coils, each ½-inch long with a ¼-inch space in center. Loops to fit 8–32 screw spaced 2 inches, formed on each end.

L$_{11}$—2 turns No. 12 plastic insulated solid wire, ½-inch diameter with a loop to fit a No. 6 screw on one end.

L$_{12}$—4 lengths of ¼-inch O.D. copper tubing, 2 each, 6 inches long and 5¼ inches long, with ½ inch at each end flattened and drilled to clear a No. 8–32 screw. (See Construction Details.)

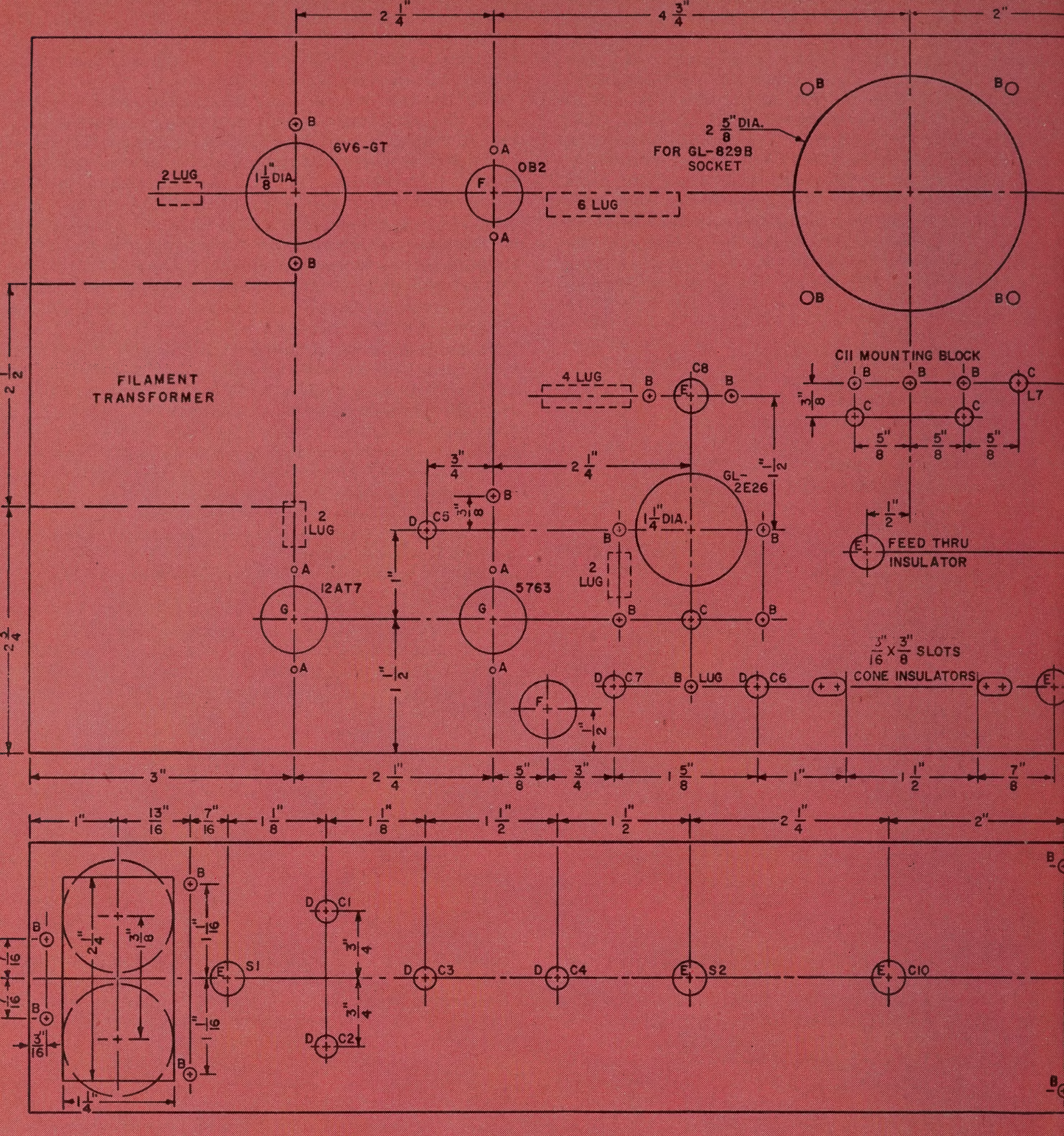

2 1/4"
4 3/4"
2"
B
B
B
B
B
6V6-GT
1 1/8" DIA.
2 LUG
A
F
OB2
A
6 LUG
2 5/8" DIA.
FOR GL-829B SOCKET
2 1/2"
FILAMENT TRANSFORMER
CII MOUNTING BLOCK
4 LUG
B
C8
E
B
B
B
B
C
L7
3/8"
C
C
5/8"
5/8"
5/8"
3/4"
2 1/4"
1/2"
GL-2E26
B
3/8"
D
C5
B
1 1/4" DIA.
B
1"
1/2"
E
FEED THRU INSULATOR
2 LUG
1"
2 LUG
A
12AT7
G
A
5763
G
B
C
B
2 3/4"
1 1/2"
A
A
3/16" X 3/8" SLOTS
CONE INSULATORS
D
C7
B LUG
D
C6
E
F
1/2"
3"
2 1/4"
5/8"
3/4"
1 5/8"
1"
1 1/2"
7/8"
1"
13/16"
7/16"
1 1/8"
1 1/8"
1 1/2"
1 1/2"
2 1/4"
2"
B
B
D
C1
2 1/4"
3/8"
1 1/16"
3/4"
B
7/16"
7/16"
E
S1
D
C3
D
C4
E
S2
E
C10
B
1 1/16"
3/4"
3/16"
D
C2
B
B
1 1/4"

Fig. 2—Chassis drilling diagram. "A" drill—No. 32, "B" drill—No. 26, "C" drill—No. 16, "D" drill—¼-inch diameter, "E" drill—⅜-inch diameter, "F" socket punch—⅝-inch diameter, "G" socket punch—¾-inch diameter. Tie-points mounted at locations indicated by dotted boxes.

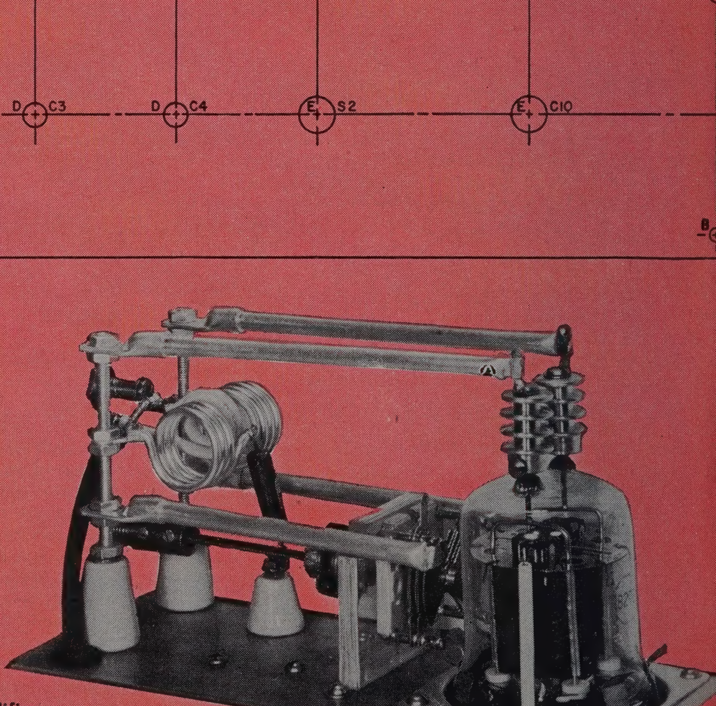
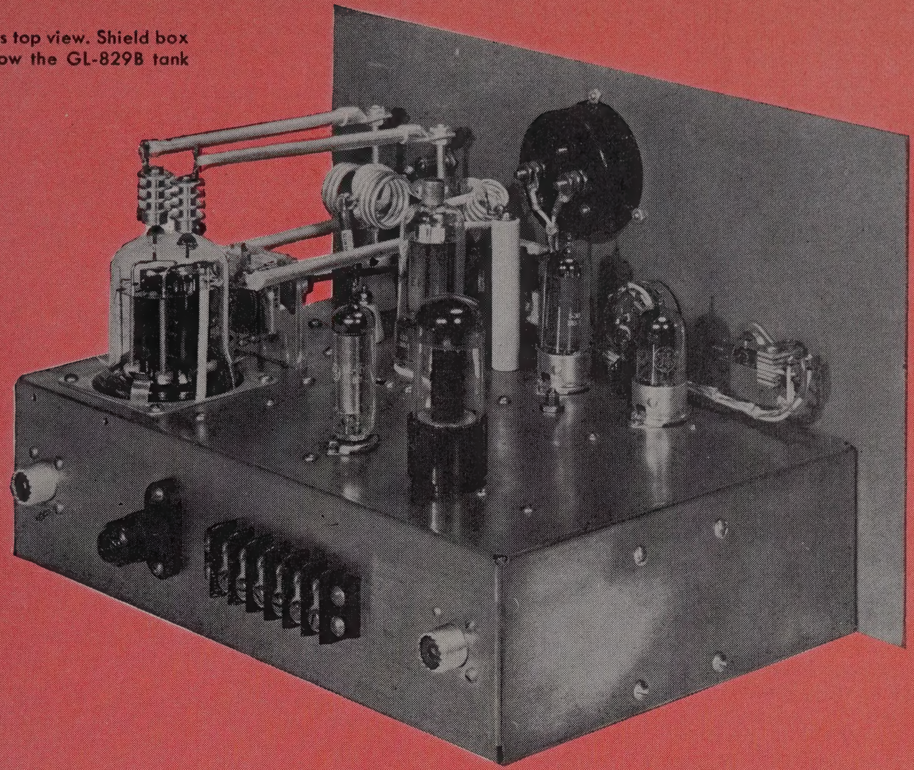
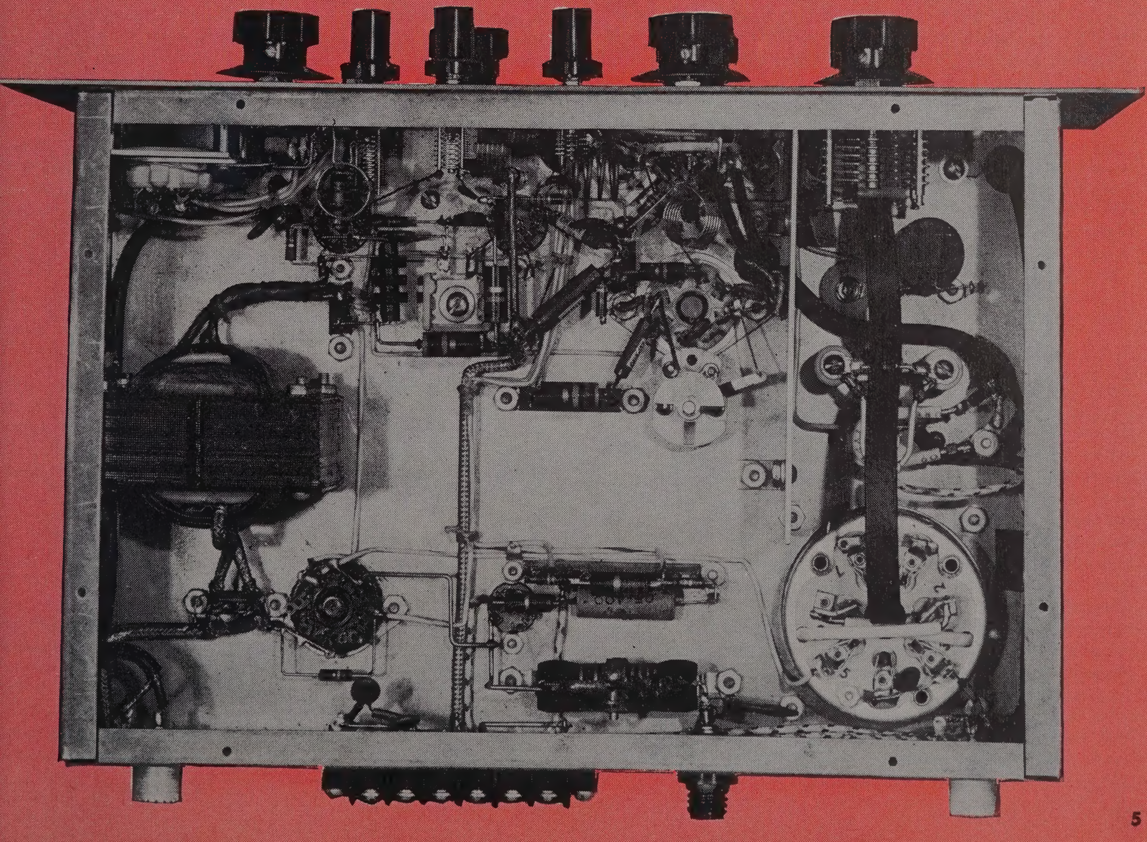


Fig. 3—Side view of GL-829B amplifier.

Fig.4. —Chassis top view. Shield box removed to show the GL-829B tank circuit.



ig. 5—Chassis bottom view.



$\frac{1}{16}$-inch thick sheet aluminum $2\frac{7}{8}$ x $5\frac{1}{4}$ inches separates the amplifier grid components from the rest of the under-chassis circuits. Grid circuit tuning capacitor C_{10} mounts on the chassis front. Half-wave grid tank circuit L_9, made from 300-ohm flat twin lead, is soldered to lugs fastened to another pair of 1-inch high cone insulators at the point where it is tapped. The ends of this line connect to the grid terminals on the GL-829B socket and to the stator lugs on the grid tuning capacitor, C_{10}. Grid coil L_7 is soldered to another pair of solder lugs on these insulators. Link coil L_8 is fastened to an 8–32 x $1\frac{1}{2}$-inch long machine screw that projects through the chassis for coupling adjustment. A hex-nut on this screw locks the adjustment after tuning the transmitter.

The two crystal octal sockets are positioned so that the crystal holders lie in a horizontal plane. They mount on a 2 x 3 x $\frac{1}{16}$-inch thick aluminum plate which has two $1\frac{1}{4}$-inch diameter and four No. 26 mounting holes drilled to match the chassis. These parts straddle the $1\frac{1}{4}$ x $2\frac{1}{4}$-inch chassis cutout on $\frac{3}{4}$-inch long spacers slipped over the 6–32 x $1\frac{1}{4}$-inch long fastening screws. Both the FT-243 and AX-2 type crystal holders will project far enough through the matching slot in the panel to be easily removed. A Mosley type 53 3-gang crystal multi-socket can be substituted if the access and mounting holes are changed accordingly. A *snap-in* cover also made from perforated sheet aluminum helps prevent radiation of 24-megacycle energy from the crystals. The two coaxial cable connectors, power terminal strip and high voltage terminal fasten along the rear side of the chassis, as shown in the bottom view, Fig. 5.

WIRING DETAILS

Shielded hook-up wire is used for all connections from the power connection strip to the parts terminal strips, filament transformer primary and heater leads to the tube sockets. The shield on these leads is grounded at each end and the center conductor on each wire is also by-passed to the shield at the power connection strip. Shortest possible leads are used for all RF and by-pass capacitor connections. Cathode pins 1, 4 and 6 on the GL-2E26 socket each have a separate by-pass capacitor to a chassis ground. Short lengths of RG-58/U coaxial cable are used for connections between the coaxial cable jacks, link coils and switches. Leads supplying plate and *screen* voltages to the 5763 and GL-2E26 should not be connected at this time. All 600-volt leads should have 2000-volt insulation and leads from beneath the chassis to S_3 were cabled. When the transmitter is mounted in a suitable table cabinet, further TVI precautions may be necessary only in areas where a fringe-level signal is received from a television station on channel 2.

ADJUSTMENT PROCEDURE

Before any tubes are placed in their sockets, all power should be applied to the transmitter and the socket voltages checked. Next, all tubes and your selection of crystals are inserted. A 144-megacycle range crystal is selected on S_1, bandswitch S_2 is set in that position and meter selector switch S_3 is turned to position "A." Plate and *screen* voltage is applied temporarily to the 5763, but not to the GL-2E26 or GL-829B tubes. With crystal feedback capacitor C_2 set about 1 turn from maximum capacity, C_1 is rotated until the meter shows a grid current rise in the 5763 stage. Next, C_2 is turned slowly toward maximum capacity until oscillation stops, then toward minimum capacity until crystal oscillation again starts. Doubler tuning capacitor C_3 is adjusted for a sharp rise in 5763 grid current. After turning S_3 to position "B," C_4, C_7 and spacing of the turns on L_3 are adjusted for maximum grid current on the GL-2E26, with C_4 tuning to resonance near minimum capacity.

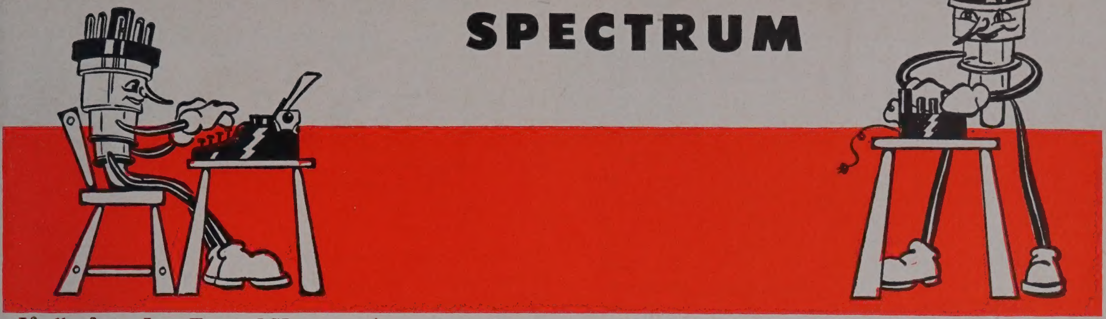
To neutralize the GL-2E26, capacitor C_8 is adjusted until there is no fluctuation in grid current as plate tuning capacitor C_9 is rotated. If this stage will not neutralize with a straight lead from the socket screen terminal to C_8, a small loop in this lead may be necessary. The plate and screen voltage lead to this tube is now connected and S_3 is moved to position "C." The turn spacing of L_5 is adjusted so that C_9 resonates with this coil near $\frac{1}{3}$ of maximum capacity. Link coil L_6 is now inserted at the end of L_5 attached to C_9. After setting S_3 to position "D," C_{10} and L_8 are adjusted for maximum grid current on the GL-829B. Length of the L_9 twin lead is adjusted to tune with C_{10} near minimum capacity. Link coil L_6 is then cemented in place.

The GL-829B is now neutralized by checking the grid current fluctuation as neutralizing wires C_N are slowly bent away from the tube while tuning plate circuit capacitor C_{11}. On the test model, these wires were clipped off until neutralization was obtained with the wires close to the glass envelope, $1\frac{1}{2}$ inches above the ceramic socket wafer. Plate voltage is then applied to this tube and a suitable 50-ohm dummy load connected to coaxial output connector J_2. Resonance near the minimum capacity setting of C_{11} should be established by adjusting the spacing of the L_{12} copper tubing by moving the supporting cone insulators in their fastening slots, shifting the tubing ends on the C_{11} stator lugs and changing the length of the flexible straps on the plate caps, if necessary. The tank circuit cover should be in place after each adjustment, as this added capacity to ground lowers the resonant frequency about 10 megacycles.

For 50-megacycle operation, S_1 and S_2 are set in that position, S_3 is turned back to position "A" and the plate and *screen* voltage is removed from the 5763 tube. The oscillator and doubler are re-tuned and output capacitor C_6 is set near maximum capacity. The 5763 stage is neutralized by adjusting C_5 for no grid current fluctuation when C_4 is rotated. Some adjustment of the 1-turn loop from C_5 to the tube socket may be necessary for complete neutralization. After again connecting plate and screen voltages to this stage, S_3 is set at position "D" and both C_4 and C_6 are adjusted for maximum grid current on the GL-829B. Sufficient driving power should be obtained with the same setting of L_8 used for 144 megacycles. Inductance of both L_7 and L_{10} is adjusted so that 50-megacycle resonance on C_{10} and C_{11} occurs near the maximum capacity settings. A strong third harmonic of the 50-megacycle output from the amplifier may result if the tank circuits are not adjusted in this manner. The 20,000-ohm adjustable screen voltage dropping resistor should be set to obtain 200 volts on pin 2 of the OB2 regulator tube when the amplifier is running at the normal 600-volt, 170-milliampere CW input.

The measured plate circuit efficiency of the GL-829B on 144 megacycles was 64% when the transmitter was fed into a laboratory-type RF wattmeter. Apparently due to the rather bulky tank circuits, the amplifier efficiency dropped to 60% on 50 megacycles. For comparison purposes, another GL-829B amplifier was constructed using conventional 50-megacycle tank circuits and driven from the same exciter. The measured efficiency of this amplifier was checked at 66%. This slight difference in efficiency will not be noticeable when the transmitter is put on the air. In conclusion, the saving in parts cost of being able to utilize this transmitter on two widely separated bands where normally separate units are used was considered to be well worth the slight compromise mentioned above. For final "dressing up," Johnson type 116–222–5 line-indicator dials were mounted on the controls shown in the cover view. Also used were 3 type 116–214–2 knobs which fit the $\frac{3}{16}$-inch diameter shafts on the midget type "M" capacitors. Panel marking and dial decals label the controls and frequency ranges covered.

SWEEPING *the* SPECTRUM



If all of my Log Form QSL cards (see this column in Volume 10, Nos. 4 and 5 issues of G-E HAM NEWS, for details and illustration) that were printed in the first press run were placed in a single pile, the resulting stack of cards would equal the size of a radio amateur's "dream" antenna tower, almost 500 feet high!! The flood of orders we have received for these cards is whittling that pile down pretty fast. A surprising number of requests have arrived for 600, 900, 1200, 1500 and in one instance, 6600 cards!

If you have the need for an inexpensive QSL card on which you can copy information in the same order that it appears in your station log, simply write me at the Tube Department, General Electric Company, Schenectady 5, N. Y. Packages of 300 cards, or any multiple of that number, will be delivered to you, postpaid, for a remittance of one dollar per 300 cards. At this price, we cannot accept requests for C.O.D. shipment or billing at a later date. The above address applies only to radio amateurs in the United States, Canada, Alaska, Hawaii and the Panama Canal Zone. In all other countries, write: Lighthouse Larry, International General Electric Company, 570 Lexington Avenue, New York 22, N. Y.

Incidentally, before you write, check through your file of back issues of G-E HAM NEWS. If any are missing, just tell me which copies you need and I will gladly send them to you as long as my supply lasts.

* * *

One of the first orders for my Log Form QSL card was received from a true "Hamm" family. In fact, both the OM and XYL are "C. W. Hamms." I really mean Carl W. Hamm, W9DWH (Dad Works Hard) and Charlotte W. Hamm, WN9UNY (Until Next Year), of Milwaukee, Wisconsin. They also have an eight-year old junior op, Jeffry C., who may be labelled, "Junior Class," when he gets his ham ticket. Carl works 7-megacycle CW and phone and 28-megacycle phone. Charlotte can be heard in the 7-megacycle novice band. They are now looking for a contact with W4-NYX, of Shelby, North Carolina. Why? He is Clyde W. Ham!

* * *

Does your basement-level radio shack suffer from excessive humidity that plays havoc with receiver and VFO calibration? A recent copy of the REA NEWS, published by the Saint Paul (Minnesota) Mobile Radio Club, suggests that you can help keep your equipment dried out by getting on the air daily! The main idea is to keep the temperature of the equipment or basement a few degrees above the dew point, below which condensation of water vapor in the air occurs. Placing a few light bulbs in your equipment cabinets may be all that's necessary to keep out the dampness. An electric de-humidifier also will do a good job. By all means, vent that automatic clothes dryer to the outside—some types release vast amounts of moisture into the air.

* * *

After recently receiving comments from a few fellows that they have been unable to buy the type 6CA5 audio power amplifier tube used in the HAM-SHACK INTERCOM described in the May–June, 1955 issue of G-E HAM NEWS, I decided that the situation needed checking into. Result—our receiving tube sales section says that there is not a large replacement demand for this tube and it may not be readily available. Fortunately, the electrical characteristics are similar to the more popular 6BF5, except for a lower power sensitivity. The only changes necessary to use this tube will be to reverse connections to pin 1 and 2 on the 6CA5 socket and change the lead from output transformer T_2 from pin 7 to pin 5.

I suppose that by now a number of these units may have been built using other output tubes that happened to be handy in the junk box. By applying the appropriate voltages, types 6AQ5, 6V6-GT or 6K6-GT might be used. Even a 6L6-GB might be your *bottle* if the local QRM is high!

* * *

I asked the editor the other day why most recent gear built for G-E HAM NEWS has included a small square of *do-it-yourself* perforated aluminum sheet. "Well," he said, "That particular type of aluminum has a pleasing decorative pattern, is easy to cut and bend with hand tools and makes a pretty good RF shield." Note that a complete shield of this material surrounds the GL-829B amplifier on the "Bonus 100" transmitter in this issue. Then he gave me a sneak preview of some of the equipment which is scheduled to appear in future issues of G-E HAM NEWS—and this material is used for shielding in several places. So, here's a tip straight from Lighthouse Larry. Keep a sheet of that stuff handy at your workbench if you intend to try your hand at some of our latest designs. The boss won't rest until he has used it all up!

* * *

The editor of one of the larger amateur radio club bulletins says that he is considering the possibilities of a stacked array of folded dipoles for 2400 MC. Want to know the source of the material? His 300-ohm feedline got caught in the power lawn mower.

Gang—just a reminder that the deadline for entering nominations in the Fourth Annual Edison Radio Amateur Award is January 3, 1956. Complete details were published on page one of the September and October issues of QST, September issue of CQ and on page 8 of the September–October issue of G-E HAM NEWS. Or, you can obtain a copy of the rules by dropping me a postcard. The award means national recognition and a nice cash bonus for the winner. Send those nominations in now to the Edison Award Committee, General Electric Company, Tube Department, Schenectady 5, N. Y.

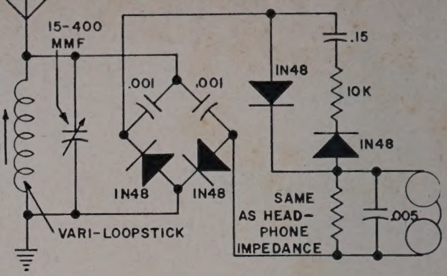
—*Lighthouse Larry*

OPERATION CRYSTAL

Several interesting construction hints about the preparation of small to medium sized plastic boxes to house crystal radios have been passed along by L. B. Cebik, W1APS, of Stratford, Connecticut. Their transparency, shock resistance and low cost make them almost ideal if the following precautions are observed.

When drilling holes in the plastic, small cracks may appear in that area. To avoid this, a wire or rod of the proper diameter is heated with a soldering iron or flame and pressed through the plastic. This method can also be used for wire leads that must pass through the case. Larger holes for control shafts can be cut with a razor blade. Instead of using bolts (and holes) to mount coil forms or small parts, cement them in place with household cement. Larger diameter coils can be wound directly on the outside or inside of the plastic box, with the turns cemented in place. Control knobs and terminals can be located on an unused side of the case.

"Where will your crystal set be when an emergency comes? On some forgotten shelf or buried in the junk box? Not mine!" —says H. G. Weist, Jr., K2AWA, of Schenectady, N. Y. "My crystal radio is patch-corded to the phono-input jack of the family television receiver. It is used almost daily to get news and other special radio programs from the local broadcast station. Being in constant use, I will have no trouble finding it and putting it to good use if and when the time comes—. Remember—you can't use it if you can't find it!"



The bridge circuit detector plus *diode network* circuit shown above is your meat if your late rich Uncle Sparky bequeathed you a shoebox full of crystal diodes. Increased output was measured when the headphones were connected as shown over that obtained when the 'phones were connected across the output of the bridge detector. Drop me a line if you have a good explanation. Any old broadcast type variable capacitor can be used for tuning across the vari-loopstick coil, or you can substitute your favorite antenna input circuit for his, says Philip Benedict, ex-WN8KKR, of Columbus, Ohio.

All ideas submitted before December 1, 1955, will be eligible for publication in the OPERATION CRYSTAL Column. (See G-E HAM NEWS, Volume 10, No. 1.) Do not send in your model! Submitters of the three ideas published in each issue receive certificates for $10 in G-E Electronic Tubes. Be sure to give complete coil-winding data for home-wound coils. All material submitted must be free from patent restrictions and becomes the property of G-E HAM NEWS.

—*Danny Diode*

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PARASITICS

Vol. 6, No. 5, p. 2

This is more of a clarification than a correction, and it pertains to the circuit diagram on page 2 of the September–October, 1951, HAM NEWS. The connection from the top of S_3 does connect to pin 2 of the 6AL5, despite the fact that no dot is shown at the connection point.

Vol. 7, No. 4, p. 2

In the schematic of the Mobile-Marine Receiver of the July–August, 1952 issue of G-E HAM NEWS two changes should be made: (1) The arm of SW-1A should be grounded; and (2) the connection between the cathode of the 6BE6 mixer and the junction point of R5 and C10 should be eliminated.

Vol. 9, No. 1, p. 6

In the "Designer's Corner" of the last issue of G-E HAM NEWS (Volume 9, No. 1) the formula for the resonant frequency should of course, have read:

$$f = \frac{1}{2\pi\sqrt{LC}}.$$

Vol. 9, No. 5, p. 4

In the 220-megacycle converter in the September–October, 1954, issue of G-E HAM NEWS (Vol. 9, No. 5), coils L_1, L_2, L_4 and L_{10} should be wound on ¼-inch forms instead of ½-inch forms as described in the parts list. Also, RFC_5 should have 15 turns, instead of 5.

Vol. 10, No. 3, p. 4

A Type 6BF5 audio power amplifier tube can be used in place of the 6CA5 shown in the schematic diagram o the Ham Shack Intercom, if that type is not readily available. Reverse socket connections to pins 1 and 2 and change the lead from the output transformer, T_2 from pin 7 to pin 5, to use the 6BF5.